

3rd
PUBLIC LIBRARY
JUN 2 1957

Current Science



Vol. 26, No. 4

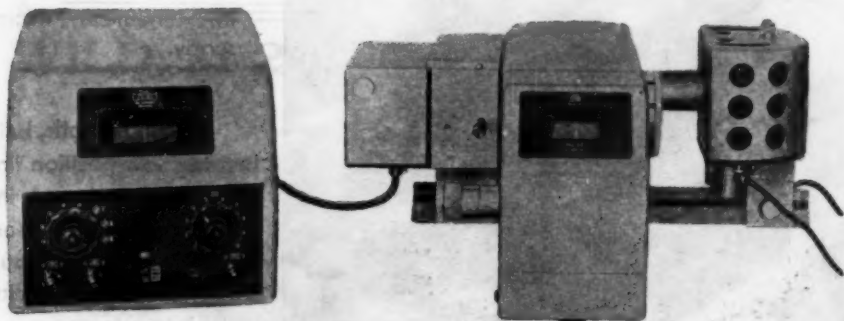
APRIL 1957

Pages 101-132



SPECTROPHOTOMETER

Mains-operated Model PMQ II



Made by Carl Zeiss, Oberkochen, Germany.

For precise measurements from 200 $m\mu$ in the ultraviolet to 1000 $m\mu$ in the near infrared region with high spectral resolution. Write for illustrated literature.

Sole Agents

ADAIR, DUTT & CO. (India) Private LTD.

CALCUTTA MADRAS SECUNDERABAD BOMBAY NEW DELHI

BAUSCH & LOMB



DYNOPTIC POLARIZING MICROSCOPES



New Models

Series 'S'

for routine student instruction

Series 'I'

for advanced student instruction, and industrially for quality control

Series 'M'

for chemical microscopy.

All the **Dynoptic**, ball-bearing, low position fine focussing stand and the finest optics. These are precise optical tools, built to last a lifetime to useful, reliable service.

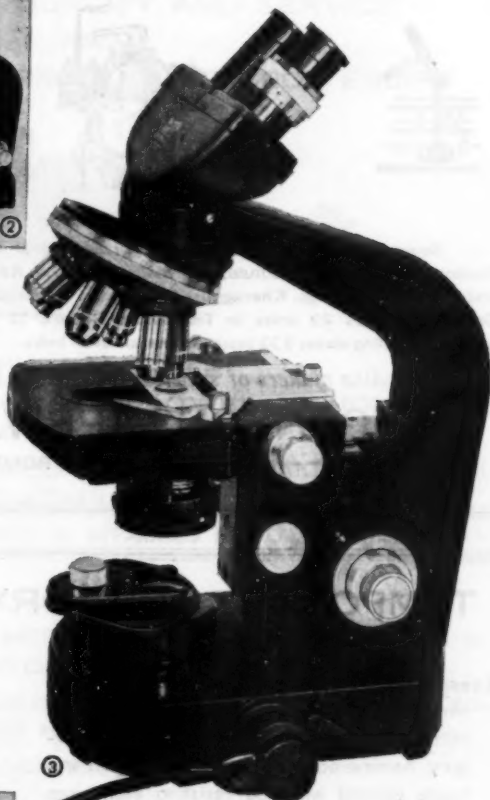
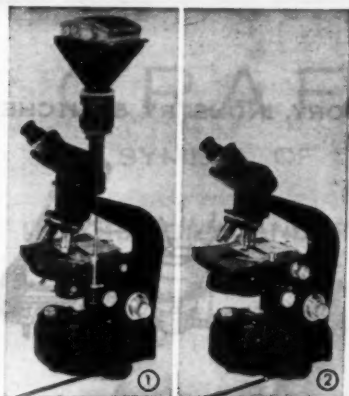
Sole Agents

MARTIN & HARRIS (PRIVATE) LTD.

(SCIENTIFIC DEPARTMENT)

SAVOY CHAMBERS, WALLACE STREET, BOMBAY 1

WILD
HEERBRUGG



* The most COMPLETE
Microscope so far
made

* Ideal for QUALITY
PRECISION
& VARIETY

WILD M 20



Sole Agents:

RAJ-DER-KAR & CO.
COMMISSARIATE BUILDING, HORNBY ROAD
BOMBAY-1

Telephone : 26-2304

Telegram : TECHLAB

Our Sub-Agents:

The Central Scientific Supplies Co., Ltd.

No. 2, Agaram Road, Tambaram, Madras

The Upper India Scientific Works

Morigate, Delhi

The M 20 Microscope with few of its attachments

Fig. 1 : With Micro Camera and Binocular Tube;

Fig. 2 : Equipped as Phase Contrast Microscope;

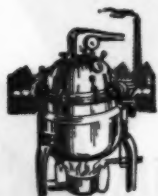
Fig. 3 : With Six-Hole Nosepiece; Filter Exchanger,
etc.;

Fig. 4 : Built-in Illuminator for Kohler Illumination.



GAS PLANT

FOR LABORATORY, INDUSTRY & KITCHEN



Installed at :

Several important Laboratories, viz., Central Drug Research Institute, Lucknow, Central Salt Research Institute, Bhavnagar, Central Road Research Institute, Delhi, Indian Institute of Technology, Kharagpur, Ahmedabad Medical College and Armed Forces Medical College, besides 20 units in Travancore-Cochin, 12 in Andhra, 6 in Madhya Pradesh recently totalling about 300 installations all over India.

Also makers of superior laboratory fittings & equipment

GANSONS (PRIVATE) LTD.

P.B. No. 5576, BOMBAY 14

TEMPO LABORATORY EQUIPMENT

Construction: Double-walled mild steel construction with 2" gap between the walls filled with fibre glass. Outside finished in silver-grey hammered tone synthetic enamel and inside painted with heat-resisting aluminium paint.

Size: (working space) 14" x 14" x 14"

Heating: Electrically operated on 230 V., 50 cycle, A.C.

Maximum Temperature: 250° C.

Temperature control: by means of a bimetallic thermostat. Variation not more than $\pm 1^\circ$ C.



Manufactured by:

HOT AIR OVEN

TEMPO INDUSTRIAL CORPORATION (PRIVATE) LTD.

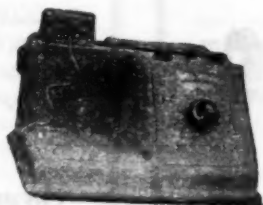
1st Floor, Devkaran Mansion, Princess Street, BOMBAY 2

CRAFTSMAN

A SYMBOL OF QUALITY AND SERVICE

—FOR—

LABORATORY AND PROCESS CONTROL EQUIPS



CRAFTSMAN OFFER

- A COMPLETE RANGE OF PHOTOELECTRIC COLORIMETERS FOR CLINICAL, METALLURGICAL & BIOCHEMICAL COLORIMETRY.
- OVENS & INCUBATORS, LABORATORY FURNACES, LABORATORY PYROMETERS, THERMOSTATS, ETC., BUILT BY CRAFTSMAN
- BOMB COLORIMETERS, EQUIPMENT & APPARATUS FOR OIL & CEMENT LABORATORIES
- L. & N. POTENTIOMETERS & GALVANOMETERS
- CAMBRIDGE PYROMETERS, pH METERS, SPOT GALVANOMETERS, D'ARSONVAL GALVANOMETERS, THERMOCOUPLES, POTENTIOMETERS, ETC.
- W. G. PYE'S POTENTIOMETERS, SCALAMP GALVANOMETERS, FLUX METERS, MICROSCOPES & KOHLRAUSCHES BRIDGE FOR CONDUCTIVITY MEASUREMENTS
- PHOTOVOLT pH METERS & COLORIMETERS

All ex-stock — no waiting for import licences and supply delays



ADDRESS YOUR INQUIRIES TO

CRAFTSMAN ELECTRONIC CORPN. (PRIVATE) LTD.

Laboratory, Factory & Office

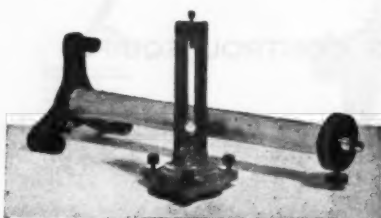
SETHNA HALL, NESBIT ROAD, MAZAGAON, BOMBAY 10

Phone : 42346



MAGNETISING SOLENOID

FOR
HYSTERESIS EXPERIMENTS



NEW DESIGN FOR USE
VERTICALLY OR HORIZONTALLY
WITH LEVELLING SCREWS

Made by:

**THE STANDARD SCIENTIFIC
INSTRUMENTS Co.**

115, BRODIES ROAD, MADRAS 28

*For standard of quality
always insist on*

OSTER'S PRODUCTS

- SODIUM SULPHATE CRYST. ANHYDROUS
- PLASTER OF PARIS
- MINERAL ACIDS, Tech., B.P., C.P., A.R.
- LIQ. AMMON. FORT, all grades
- ACCUMULATOR ACIDS, S.G. 1840
- DISTILLED WATER, Single, Double
- LABORATORY CHEMICALS, ETC.
- DISINFECTING FLUIDS, Dingi Brand

Manufactured by:

**OSTER
CHEMICAL & PHARMACEUTICAL
WORKS (Private) LTD.**

Reg. Office:

78 B, Manicktola Street, CALCUTTA 6

Works:

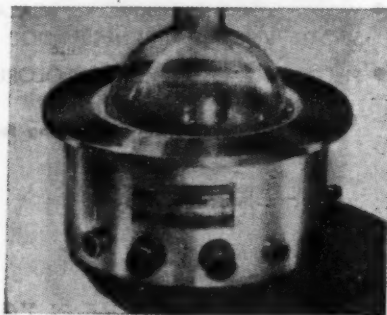
Bagmari Road, CALCUTTA

ESTD.: 1922

RAM: JAJAX 4A

ELECTROTHERMAL HEATING MANTLES

Available Ex-stock in various sizes:



Contact:

LABORATORY FURNISHERS

DHUN MANSION, VINCENT ROAD, DADAR, BOMBAY 14

GRAMS: "LABFURNISH" BOMBAY-DADAR

PHONE: 62761

Branch: AHMEDABAD

PROGRESS IN

CHROMATOGRAPHY 7

PAPER TECHNOLOGY — ITS CONTRIBUTION TO A GROWING SCIENCE

In our previous six advertisements we have described most of the important chromatographic techniques. Throughout, the emphasis has been on the impetus given to organic, inorganic and biochemical analysis by paper chromatography, and on the opportunities for its use that still exist unexploited in many laboratories.

In this, the last advertisement of the series, our concern has shifted from chromatography itself to the paper that makes it possible. A problem the paper technologist has to face is the absence of any complete theoretical account of what happens to solutes and solvents within the cellulose texture. Lacking a definitive physical chemistry, he must apply to paper production not only his technical knowledge, but also an empiricism born of considerable craftsmanship and experience.

It is entirely due to the technologist's skill that papers have been evolved with the diverse properties required by an ever-growing number of chromatographic techniques. By closely controlling the quality of his products, the technologist has produced papers of a purity which compares favourably with that of analytical chemicals.

* It would be of assistance if you would quote the reference CHy when writing for these booklets.

H. REEVE ANGEL & CO. LTD
9 BRIDWELL PLACE LONDON EC4
also at 52 Duane Street New York 7

For many years the Balston laboratories have explored, exploited and advanced the technology of paper at a pace which has entirely satisfied the need for a variety of physical properties embodied in a wide range of shapes and sizes. Today an unexcelled range of Whatman papers can be offered both for chromatography and for its kindred technique, electrophoresis. Papers are made in circle, sheet, strip and the economical reel form. For specialised techniques pattern forms are available or can be cut to order.

Trial packets with a selection of standard papers are marketed for the benefit of laboratories which, as newcomers to chromatography, wish to discover the most suitable paper for their needs.

These and other of the properties and advantages of Whatman filter papers are discussed in the booklet 'Buyers' Guide'. You will find it and its companion Price List useful. Write for free copies to the address below.*



Sole Distributors of

WHATMAN FILTER PAPERS

(Manufacturers W. & R. Balston Ltd.)

INJECTABLES — Safe and Dependable



A wide range of parenteral preparations for meeting the growing requirements of the Medical Profession are now being processed in our Laboratories. They are made from Standard Chemicals employing double distilled and PYROGEN FREE water. Their containers (Ampoules) undergo rigid neutrality tests before they are selected for use. These Injectables are therefore guaranteed to be absolutely safe and dependable.

The following are but a few of our well-known Injectables :

● RETICULIN	A Potent extract of Liver
● HEXOPURIN	An urinary Antiseptic
● CALCITOL	Injectable Calcium Gluconate
● BEVITAMIN	" Vitamin B ₁
● CEVITAMIN	" Vitamin C
● GLUCOSE SOLN.	" Pure Dextrose

The Mysore Industrial & Testing Laboratory Ltd.

Malleswaram P.O., Bangalore 3

Bengal Chemical and Pharmaceutical Works, Ltd.

The Largest Chemical Works in India

Manufacturers of Pharmaceutical Drugs, Indigenous Medicines, Perfumery, Toilet and Medicinal Soaps, Surgical Dressings, Sera and Vaccines, Disinfectants, Tar Products, Road Dressing Materials, etc.

Ether, Chloroform, Mineral Acids, Ammonia, Alum, Ferro-Alum, Aluminium Sulphate, Sulphate of Magnesium, Ferri Sulph., Potassium Permanganate, Caffeine and various other Pharmaceutical and Research Chemicals.

Surgical Sterilizers, Oxygen Apparatus, Distilled Water Stills, Operation Tables, Instrument Cabinets and other Hospital Accessories.

Chemical Balance, Scientific Apparatus for Laboratories and Schools and Colleges, Gas and Water Cocks for Laboratory use, Gas Plants, Laboratory Furniture and Fittings.

Fire Extinguishers, Printing Inks.

Office: **6, GANESH CHUNDER AVENUE, CALCUTTA-13**

Factories: **CALCUTTA - BOMBAY - KANPUR**

THERMOSTATIC BATHS

(WATER OR OIL)

Various sizes and temperature ranges for general laboratory work. Maximum dimensions 18" x 18" x 12". Maximum temperature upto 300° C. Accuracy of control to within $\pm 0.05^\circ$ C. Efficient Stirring, with glass walls on two sides for good visibility, and metal framework for strength. Switch-board and control box attached to one of the sides.

Entirely Our Manufacture

For full particulars, please write to :

**THE GENERAL
ENGINEERING AND SCIENTIFIC CO.**

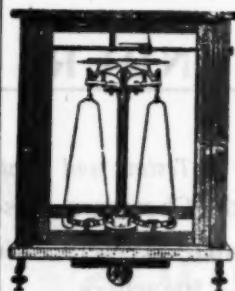
WALTAIR, VISAKHAPATNAM-3

(S. INDIA)

Technical Adviser :

Dr. I. RAMAKRISHNA RAO

M.A., Ph.D. (Cal.), D.Sc. (Lond.)



KEROY
Short Beam
Analytical
Balance

No. K 1

A Really Dependable Balance for Degree
Classes and Research Laboratories

Sensitiveness .. 1/10th mg.

Capacity .. 200 gm.

Fitted on $\frac{5}{8}$ " thick glass base Price: Rs. 325/-

Catalogue on Request

Manufactured by:

Keroy (Private) Ltd.

BANARAS CANTT.

.. CALCUTTA 10

All In One

INDEX
REAGENT BOTTLES

Made by

Sigcol



Sole Distributors

GHARPURE & CO.

P36, ROYAL EXCHANGE PLACE
EXTENSION - CALCUTTA-1

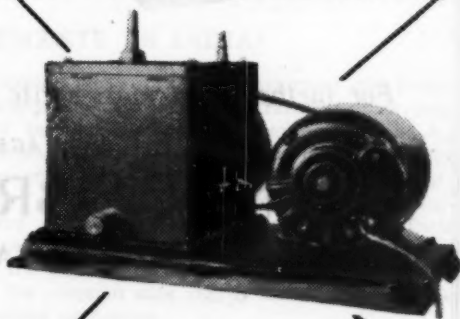
GRAM-MEENAMO PHONE-22 2061

MADE IN INDIA

HIGH VACUUM ROTARY PUMP

Single Stage & Two Stage

Suitable for Laboratory use and
similar in performance to those made
in Germany, England & U. S. A.



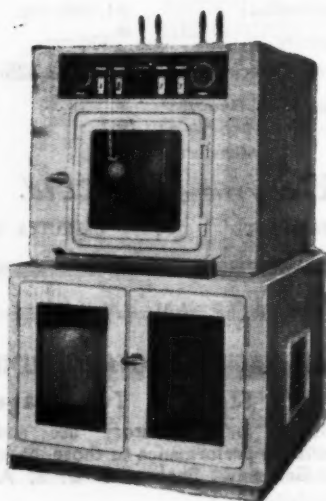
All Indian Materials
and Constructions.

Basic & Synthetic Chemicals (Private) Ltd.
P. O. Jadavpur College, Calcutta-32

BRABENDER, O.H., GERMANY

Manufacturers of Testing and Control Equipment like

Climatic Chambers, Viscographs, Plastographs, Extensographs, Moisture Testers, Grinding and Pulverising Mills and Electric Flour Bleachers.



BRABENDER'S CLIMATIC CHAMBER for testing of materials under all climatic conditions; operating range -40°C to $+90^{\circ}\text{C}$; relative humidity 10% to 95%. These Climatic Chambers have been successfully used in Scientific and Research as well as in Industrial Organisation, specially for Chemical, Plastic, Wire and Electrical Equipments, Paints, Varnishes, Metals, Food Products, Tobacco Testing, etc.

For further particulars write to:

SOLE AGENTS IN INDIA

TOSHNIWAL BROS. (Private) LTD.

198, JAMSHEDJI TATA ROAD, BOMBAY 1

BRANCHES:

**14 B/4, N.E.A.
Uttari Marg
NEW DELHI 5**

**9, Blacker's Road
Mount Road P.O.
MADRAS 2**

**31, Ballygunj Place
CALCUTTA 19**

Current Science

Vol. XXVI]

APRIL 1957

[No. 4

	PAGE		PAGE
Engineering Achievements in India ..	101	Chemical Elements beyond 92 ..	108
Symposium on High Polymers ..	103	Heart-Lung Machines ..	109
Simulation of Astrophysical Processes in the Laboratory ..	104	Letters to the Editor ..	110
Some Recent Advances in the Photoelectric Field—P. A. GÖRLICH ..	105	New Apparatus at the Physical Society Exhibition ..	126
New Type Nuclear Reaction ..	107	Reviews ..	127
New Uses for Atomic Waste Products ..	108	Science Notes and News ..	131

ENGINEERING ACHIEVEMENTS IN INDIA*

UNDERSTANDING and familiarity with the physical world produces the scientist. Skill of hand, ear and eye produces the craftsman or the technician. Finally these activities are most effective when they are ably co-ordinated with one another by creative genius. Such co-ordination of mind and hand is provided by the engineer who is especially equipped to do so by his education, training and experience gained from a life-time of the practice of such co-ordination. It is the effective co-operation of the scientist, the technician and the engineer that will meet the increasing demands of the growing population of the world. Already the

material world is being transformed and transformed rapidly. But the transformation may not be attributed to pure science alone. An essential element—perhaps the most important element—is the correlating faculty of the engineer. Such developments involve a large element of sound judgment and much cautious trial and error. The laurels for the adoption of the discoveries of pure science to the needs of the common man rightly belong to the engineering profession.

The achievements of Indian engineering have been considerable in the past few years. The refugee problem that followed in the wake of independence was an immense one, and the building programme to house these refugees was indeed praiseworthy. The national reconstruction demanded the construction of huge

* From the Presidential Address of Sri. Kanwar Sain at the 37th Annual General Meeting of the Institution of Engineers (India), held at Trivandrum, January 1957.

buildings and multi-storeyed structures for Governmental office buildings and other purposes; new highways with incidental bridges, causeways and other crossings; industrial townships and factories like Sindri Fertilisers; capital city constructions like Chandigarh in East Punjab and Bhubaneswar in Orissa; and many other structures of marked engineering efficiency such as the Banihal Tunnel and the Vignyan Bhavan.

The river valley development in the country is gaining momentum every day. The Tungabhadra and the Lower Bhavani Dam constructions in the South have been completed. The first phase development of the Damodar Valley is complete. Two dams, Tilaiya and Konar, and the Durgapur Barrage are already functioning. The construction of the Maithon Dam is almost over and the constructional tempo on the Panchet Hill Dam is gaining rapid pace. The Hirakud Dam with some unique features of design and construction was opened by the Prime Minister on 13th January 1957. It is the longest dam in the world measuring about 16 miles from one end to the other. The construction of the 740 feet high Bhakra Dam is progressing according to schedule and will be completed by about 1959. Koyna, Rihand, Chambal, Kosi, Nagarjunasagar and many more are under various stages of execution. An idea can be had of the magnitude of the river valley project development from the fact that the amount spent on them every year is more than what was spent during the entire century prior to Indian Independence. The development is exciting and spectacular.

The Indian Railways have registered their landmarks by the construction of the Chittaranjan Locomotive Factory and the Perambur Integral Coach Factory. The engineers of the Army have contributed their mite and shown efficiency in the construction of the Nepal Road—a national highway linking India with Nepal, the Bharat Electronics Factory at Bangalore, and the Machine Tools Factory at Ambernath. No less striking is the development in the branch of Posts and Telegraphs. Carrier current communication has been extended to most parts of the country and further development in the shape of coaxial cables for increasing the capacity of transmission between the main traffic centres is being extended.

Wireless communication including VHF facilities are being increasingly used.

Realising the importance of research in the technological development of the country, several national laboratories, technological institutions, hydro-meteorologic observatories and aerodynamic research stations have been established. As an instance in point, one may mention here the part played by the Central Water and Power Research Station at Khadakwasli in taming the Brahmaputra to save the town of Dibrugarh in Assam. It looked almost certain that the town would be swallowed up by the mighty river. Nothing short of a heroic battle for Dibrugarh was fought, with the result that the town has been saved from further danger. This was made possible through basic research conducted in the laboratory and the bold action in the field.

On the industrial side too, our development has been no less marked. The Hindustan Aircraft Factory, the Telephone Industry, Electric Cable Industry, Machine Tools and Oil Refineries are a few major ones of the many enterprises. Many new heavy industries are programmed in the Second Five-Year Plan. The stress is more on the rapid industrialisation of the country, though considerable importance is attached to the agricultural improvement projects. The basic iron and steel industry has been given great importance. The Rourkela, Bhilai and Durgapur Iron and Steel Plants are being pursued vigorously.

Special mention should also be made of the Atomic Energy Plant at Trombay. This opens up a vast field for the utilization of our extensive atomic energy resource.

Our past achievements should not make us complacent and dim our vision for the future. What was done yesterday may not suffice for tomorrow. We must develop more and more of reliance on ourselves. With this object, it is necessary that the Indian engineers are given the opportunity to advance their technical knowledge by specialised study and training to equip them to shoulder greater and greater responsibilities. The challenge of these responsibilities will make them grow.

There is certainly enough talent in the country. What is required is a correct orientation and channelising of available talent on the right lines.

SYMPOSIUM ON HIGH POLYMERS

A SYMPOSIUM on high polymers was held recently under the auspices of the National Chemical Laboratory and the Plastics Research Committee, C.S.I.R., at the National Chemical Laboratory, Poona, and more than 150 delegates from different parts of the country and Prof. G. Champatier from France participated in it.

Professor Finch in his opening remarks observed that a symposium like the present one performs a very significant and useful service and that the scientist and industrialist should meet often to exchange ideas and understand mutual problems of interest. In India, due to its geographical vastness, scientists find it difficult to meet often, but such symposia provide a great opportunity for the industrialists and scientists to discuss together and work out fresh ideas and solve their problems.

Explaining the scope and objectives of the symposium, Dr. S. L. Kapur, Assistant Director, Plastics and Polymers Division, National Chemical Laboratory, pointed out that a first symposium on high polymers in the form of a restricted conference was organised at the National Chemical Laboratory in April 1951. During the past few years, the Laboratory organised two symposia on rubber and one each on ion-exchange, surface coatings and vegetable oils. These symposia were highly successful and provided a convenient media for the exchange of views between the manufacturers and research workers.

The last few years have seen a remarkable upsurge in the progress of macromolecular chemistry. This activity has been stimulated not only by the intrinsic interest and striking practical applications of new and better polymers but also by developments of new techniques for the separation and identification of large molecules and for determination of their molecular weight, shape, structure and mode of packing together.

A great emphasis is being laid on the development of these industries during the Second Plan. The proposed expansion of the plastics industry includes the establishment of a plant for polymerisation of styrene monomer, two units for the manufacture of polyethylene and one unit for the manufacture of polyvinyl chloride from acetylene, in addition to the proposals under consideration for the indigenous manufacture of urea formaldehyde moulding powders and a few other products. A synthetic rubber plant at an estimated cost of one crore of rupees is projected by the Government and the possibilities for the manu-

facture of styrene monomer at the (Rourkela) Steel Plant are being explored. The Rubber Board has an ambitious plantation scheme for raising the present indigenous production of natural rubber from about 24,000 tons to about 32,000 tons by 1966 and to 52,000 tons by 1975. Similarly, the present 44 tons daily production of viscose is likely to be stepped up to 165 tons a day or about 132 million pounds annually. The utilisation of byproducts of petroleum refineries for the manufacture of polymers is yet another rising star in this field.

No doubt the new industries are being established with the help of imported 'know how', but for their ultimate successful implementation and subsequent maintenance and progress, there is bound to be a great demand for scientists and technologists. The shortage of trained persons in these fields is being already felt and it could be partly overcome by introducing polymer chemistry at post-graduate level in some of our universities. The present problems of these growing industries are insignificant in comparison to those which are likely to arise 5 to 10 years from now, when indigenous production will have to compete with the new and improved products that will continue to be tailor-made to meet higher standards and more rigid specifications.

To fulfil these promises and for the sound foundation of this industry, the importance of research cannot be exaggerated. The experience of other advanced countries would serve to convince our industry of the high dividends of investment in research in this field.

Dr. Lal C. Verman, Director, Indian Standards Institution, and Chairman of the Plastics Research Committee of the C.S.I.R., then briefly outlined the growth of the two organisations. He hoped that, in view of the vast progress made every day in industry and science, such symposia will become a regular feature and that scientists and industrialists could meet often. Outlining the scope of the Indian Standards Institution in the present context, Dr. Verman said that standards and standardisation have a great part to play in plastics industry, and that they have to be suitably modified and adapted to suit Indian conditions.

Referring to high polymers, Prof. Thacker, Director-General, C.S.I.R., who inaugurated the symposium, said that in recent years quite a lot of work has been done in this field. The role played by plastics in industry today is dynamic; the fibre industry, the plastics

industry and associated industries have now entered a larger sphere in engineering and fabrication.

However, in regard to the consumption of plastics goods, India stands no comparison to U.S.A. and the Western countries. Indigenous fabrication and production must therefore be stepped up. In U.S.A. the *per capita* consumption was 22 lb., while in U.K. it was 14 lb. In the development plan of U.S.A. they are aiming to increase it further. This only signified the need and importance of tapping the potential field for development of the plastics industry in India. Prof. Thacker mentioned the plastics bridge in Louisiana in U.S.A., and stressed the engineering applications and possibilities of plastics. The importance and need for research development and industrial applications was vital. The demand from industry was great and is bound to increase day by day. Eastern countries like Japan have also advanced a long way in the field of plastics. Scientists, technologists and industrialists are busily engaged here in India in advancing the plastics industry and must needs discuss and solve mutual problems and exchange ideas and views and explore new possibilities and avenues of advancing the cause of plastics. In this respect they have a responsibility and are being helped by various scientific institutions like the national laboratories.

A High Polymer Exhibition was also arranged in connection with the symposium, in which as many as 20 firms participated, besides the Shri Ram Institute for Industrial Research, the Indian Lac Research Institute and the National Chemical Research Laboratory. The exhibits covered products from the field of plastics, rubber and synthetic fibre industries. The exhibits at the National Chemical Laboratory stall included all relevant work on high polymers conducted at the National Chemical Laboratory and descriptive charts were also available as explanatory notes. The Laboratory also organised a world book exhibition which included display of books, journals and other relevant literature on high polymers. Demonstrations such as balloon making, preparation of lac by the Indian method were also included and these evoked keen interest among the assembled guests and delegates.

A 80-page brochure specially brought out on the occasion by the National Chemical Laboratory was distributed free to all the delegates and distinguished guests and others who attended the symposium and visited the exhibition. The brochure, besides containing a few popular articles on development plans, includes abstracts of papers read at the symposium and the list of exhibitors participating in the exhibition.

SIMULATION OF ASTROPHYSICAL PROCESSES IN THE LABORATORY

WINTON H. BOSTICK AND ORRIN A. TWITE, of the University of California Radiation Laboratory, have reported the development of a plasma gun (or plasma source) which can project plasmoids across a magnetic field in a vacuum at speeds up to 10^7 cm./sec. A Taylor-instability jet produced in a plasma supported against gravity by magnetic field may thus be simulated and studied in the laboratory. The track left by the plasmoid in crossing a magnetic field is luminous because of the recombination light of the ions and electrons which have been left behind as 'debris'. The track may thus be photographed.

If a pressure of a few microns of residual gas is used instead of a vacuum of 10^{-6} mm. mercury, the photo-ionization produced in this gas can give rise to currents that produce an electromagnetic brake on the plasmoid. This

breaking action not only decelerates the plasmoid but also deflects it into a spiral. The presence of other plasmoids intensifies this process of deceleration and deflexion.

These processes were first documented with time exposure photographs. A more spectacular demonstration of the effects can be obtained with Kerr-cell photographs, using four or two plasma sources firing simultaneously across a magnetic field under varying conditions. The authors suggest that the processes displayed in these photographs are actually related to geometrically similar astrophysical processes, involved in the formation of spiral galaxies, individual stars, barred spirals and binary stars—although the laboratory magnetic field (4,000 gauss), atom densities, distances and time-scale are very different from those obtaining in the stars. (*Nature*, 1957, 179, 214.)

SOME RECENT ADVANCES IN THE PHOTOELECTRIC FIELD*

P. A. GÖRLICH

Institute of Physics, University of Jena, East Germany

THE photosensitive cell has assumed great importance of late as an indispensable constructional element in automation, regulation and measuring systems. An outline of the new developments in two particular sectors, (i) photoelectric emission, and (ii) barrier-layer-cells is of topical interest.

PHOTOELECTRIC EMISSION

Photo-cathodes with alkali-Sb layers have been known for some 20 years, particularly those of the type Cs-Sb and Li-Sb.¹ These so-called composite cathodes then competed with the Cs-oxide-cathodes. Excepting minor variations from these two basic conceptions, there is no further innovation on record as far as the construction of photo-cathodes is concerned. However, measurements of the spectral distribution of the sensitivity of photo-cathodes were extended into the extreme ultraviolet (Schumann-region) up to about 80 mμ.² The observed high sensitivities, especially of the alkali-Sb-cathodes also in the Schumann-region, permitted us to design photomultipliers of maximum sensitivity in the ultraviolet region, thus practically removing what obstacles may have been in the way of a complete experimental exploitation of the Schumann region—so far as the receiving end is concerned—for the investigation of photochemical reactions, optical transmission through thin media, etc.

With respect to the lowest dark-currents produced by thermionic noise, a value of 10^{-17} to 10^{-19} amp./cm.² primary at the photo-cathode has been obtained for multipliers working in the visual region of the spectrum, and using Li-Sb-cathodes combined with an occasional low-temperature-cooling of these layers.³ In precision photometry of lowest light-intensities and also for scintillation measurements, the importance of this result cannot be underestimated, more especially as the proportionality between the incident flux of light and the output current of the multiplier can be guaranteed in the range of some powers of ten.

At the same time, modern technology of photomultipliers has led to a usable arrangement for verifying the existence of ions in mass spectrometers. The secondary emission part of modern multipliers is generally insensi-

tive to short-time influences of the atmosphere if an alkali-component in the secondary emission layer of the dynode stages is dispensed with, i.e., the secondary emission factor of the single stages does not deteriorate by the above manipulations.⁴ The above-mentioned multiplier dynode-systems are therefore of late used in mass spectrometers or in connection with vacuum-monochromators, i.e., in all those cases in which ion currents are to be amplified by secondary emission and also where it becomes necessary to permit air to enter for a short time into the vacuum-apparatus between separate experiments. This is done in such a way, that electrons are liberated on the first dynode by the ion current which is to be amplified. These electrons are then further amplified in the dynode system in the same way as the secondary electrons liberated by photoelectric electrons.

In a recent manual on physics, Weissler⁵ has given a very clear survey of the present state of our knowledge regarding the photoelectric emission of solids. This review could be supplemented with regard to the section on composite photo-cathodes as follows: recently it has become possible to draw certain conclusions with respect to the mechanism of composite photo-cathodes or to the actual structure of the layers themselves, if the whole phenomenon of discharge in gas-filled photo-cells, i.e., including the independent discharge, is considered as a reciprocal action with the measurable changes of the cathode-layers. Whether or not the formulation or position of the question is similar to that of the Joshi effect, cannot be decided until an adequate amount of experimental data is available. Such investigations on composite photo-cathodes have already been initiated by Kluge and his collaborators.⁶ In a dissertation suggested by us, but which has not been published so far, W. Telle has shown by experiment that, in the region of independent discharges of inert gases (under specified discharge conditions, and upon subsequent reproducible discharge phenomena) it will be possible to show increase or decrease of the sensitivity of composite cathodes as a function of these conditions, in particular, as regards their photoelectric yield. The obtained changes in sensitivity are also maintained if the filling gas is removed from the cell. Exhaustive investigations in this direction are likely to show good

* From a lecture given at the 44th Session of the Indian Science Congress, January 1957, dealing with the work done on the subject at Jena.

results in the above sense, unfavourable and intricate though the existing experimental conditions may appear.

There are various provinces where the industrial use of iconoscopes and the employment of the so-called industrial television assumes a steadily growing importance of late. There are possibilities now of visualizing images formed by rays from invisible spectral regions, of increasing the contrast and intensifying the light. The problems which arise from the above for photoelectric research consist in adapting the photo-sensitive imaging elements together with their electrical accessories to the specific applications as regards size, spectral distribution, mode of storage or amplification, choice of glass or material for windows, as well as the technology of photoelectric elements. As a result of these investigations, it may be necessary to envisage more extended photoelectric methods and the employment of image converters or image pick-up tubes in microscopy, as well as in astronomical research, in medicine, surveying, as also in taking photographs of rapid motions and in many other fields. Surprising results may occasionally be expected when using photosensitive imaging elements. For example, we have been able to show that the structure of thin sections of wolframite and manganite, if viewed microscopically in the infrared region (λ 913 or 850 $m\mu$ respectively) via an image-converter, displays a marked fine-crystalline texture while, if observed in the visible region (λ 506, 8 $m\mu$) the same layers are completely opaque.⁷ Also in astronomical research a tenfold extension of the radius of observation is anticipated in the linear scale if image pick-up tubes are employed, using the same telescope. This possibility has been pointed out of late by several astronomers.⁸ Thus a modern pick-up storage tube, if used in connection with the 200 in. Hale-Telescope on Mount Palomar, would be likely to pick up stars of the 29th magnitude.⁹

BARRIER-LAYER PHOTOCELLS

From the engineering point of view, the progress achievable with barrier-layer cells is of particular interest. The preferential employment of these cells in luxmeters, photometers and exposure-meters, particularly in portable instruments, is known to be attributable to the fact that they are operative without any outside source of power. Whereas selenium, as a semiconductor, received serious rivals in cupros oxide, silver sulphide and thallium sulphide, the selenium barrier surface cell maintains its leading position now as be-

fore. Yet, recent investigations on Cu_2O , especially by Dixit¹⁰ leave room for the possibility of this type of cell being likely to again push to the foreground by changed methods of producing Cu_2O -barrier cells (as also of Cu_2O -photo-resistance cells).

Without our having been aware of the now prevailing views on *pn*-transitions we succeeded in effecting one such transition by depositing a Cd-Se-layer on the Se-semiconductor layer of a barrier cell and in this way we obtained in addition to the known Se-maximum of the spectral distribution at ~ 580 to $600 m\mu$, another a red maximum at $\sim 710 m\mu$.¹¹ As a covering layer (conductor layer), a thin transparent metal film was sputtered or evaporated on the Cd-Se-surface (same as in the past on the pure Se-layer). Preston¹² eventually changed over to using covering layers of a semi-conducting nature, such as CdO-layers, for instance. Since then, investigators have been interested in obtaining a greater influence upon the spectral distribution in the red region by means of Cd-Se than was possible by a *pn*-transition. Such investigations are of interest also from a technical point of view, for there are many possibilities of applying highly red-sensitive Se barrier-layer cells: for instance, the important problem of the continuous supervision of the oxygen-content of blood during surgical operations, or for the purpose of studying the circulation, which can be solved with the aid of a red-sensitive cell for measuring the red absorption component ($\lambda \sim 805 m\mu$) and with a cell of suppressed red-sensitivity for measuring the absorption component at $\lambda \sim 650 m\mu$.¹³

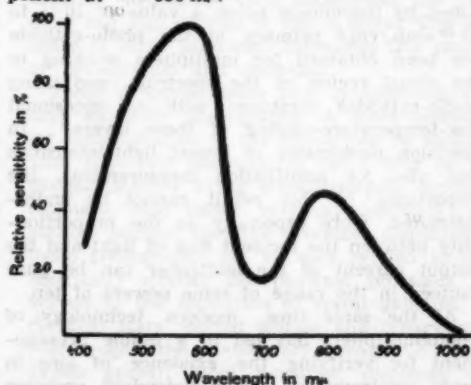


FIG. 1. Spectral distribution of an infrared photoelement.

The high sensitivity in the infrared which occur in resistance cells with thallium-sulphide, lead sulphide, lead selenide and lead telluride would seem to suggest that

selenium surfaces should be treated with thallium or lead in order to obtain transitions between the thallium-selenides or lead-selenides, respectively, and the selenium for producing infrared maxima, also in barrier-layer cells. We actually succeeded in creating maxima¹⁴ in the region of 800 m μ and, by treatment with lead, to shift the longwave limit far beyond 1 μ . By cooling down the lead-treated cells to a temperature of carbon-dioxide snow, we detected symptoms of infrared excitation of the sensitivity and a diminution in the inertia-phenomena and in the dependence on frequency. Experiments with In-Se-intermediate layers, not published so far, show a very distinct maximum near 780 m μ (see Fig. 1). The effects of the above-mentioned modes of treatment on the spectral distribution in the near and far ultra-violet have not yet been fully analysed. Rough investigations, during which the Cd-treatment was effected by means of an electrolytic method, show that such influences must be strong. A distinct new maximum near ~ 380 m μ was thereby produced.¹⁴

1. Görlich, P., *Z. Phys.*, 1936, **101**, 335; *Phil. Mag.*, 1938, **25**, 256; *J. Opt. Soc. Amer.*, 1941, **31**, 504.

2. Schwetsoff, V. and Robin, S., *C. R. Acad. Sci.*, Paris, 1951, **233**, 475, 518; 1952, **235**, 316; Görlich, P., *Ber. Arb. Tag. Biophys. Greifswald*, 1953, **19**; Robin, S., *Rev. Optique*, 1954, **33**, 193, 377; Apker, L., Taft, E. and Dickey, J., *J. Opt. Soc. Amer.*, 1953, **43**, 78.
3. Engstrom, Ralph, W., *J. Opt. Soc. Amer.*, 1947, **37**, 420; Görlich, P. and Schmidt, L., *Nachr. Techn.*, 1955, **5**, 306.
4. See e.g., Görlich, P., Krohs, A., Phcl, H. J. and Schmidt, L., *Exp. Techn. Phys.*, 1957, **5**.
5. Weissler, G. L., in *Handb. Phys.*, edited by S. Flügge, 1956, **21**, 304.
6. Kluge, W. and Schulz, A., *Z. Phys.*, 1956, **146**, 314. *Ann. Phys.*, 1956, **18**, 321.
7. Görlich, P., *Wiss. Ann.*, 1956, **5**, 724; also *idem*, *Festschr. Dt. Akad. Wiss.*, Berlin, 1956, 117.
8. *Observatory*, 1955, **75**, 185 f; *Ibid.*, 197 f; *Sympos. Astron. Opt.*, Amsterdam, 1956; *Sky and Telescope*, 1956, **15**, 168, 480.
9. Kopal, Z., *Phys. Bl.*, 1957, **13**, 4 (especially p. 12).
10. Dixit, K. R., *44th Indian Science Congress*, 1957, Calcutta.
11. Görlich, P., *Z. Phys.*, 1939, **112**, 490; Eckart, F. and Schmidt, A., *Z. Phys.*, 1941, **118**, 199; Tomura, M., *Bull. Chem. Soc. Japan*, 1949, **22**, 145.
12. Preston, J. S., *Proc. Roy. Soc.*, 1950, **202A**, 449.
13. See e.g., Kramer, K., *Z. Biol.*, 1935, **86**, 61; Matthes, K. and Gross, F., *Arch. exp. Path.*, 1939, **191**, 369, 381, 523; Brinkmann, Z., *Arch. Chir. Neerl.*, 1949.
14. Görlich, P. and Krohs, A., *Jener Jb.*, 1955, **1**, 54 (with a detailed bibliography of the earlier literature).

NEW TYPE NUCLEAR REACTION

THE observation of a new kind of nuclear reaction that yields energy and is akin to thermonuclear reactions was reported recently to the American Physical Society by scientists at the University of California Radiation Laboratory. The new phenomenon is described as "catalyzed nuclear reaction". This adds to those reactions already known to science a new and third way of making a nuclear reaction take place. The older ways are either to induce thermonuclear reactions, in which two light nuclei fuse into a heavier one when the temperature is raised to roughly one million degrees, or else to bombard nuclei with other nuclear particles from accelerators like cyclotrons or nuclear reactors.

In order to make a nuclear reaction take place, two nuclei must touch. The new discovery is a way of pulling two nuclei together so that a proton and a nucleus of heavy hydrogen (a deuteron) can combine to form helium-3 with the release of 5.4 million volts of energy. This pulling together takes place in a mesic molecule.

In a normal molecule the nuclei of the component atoms are pulled together weakly by

electrons. But the electron can be replaced by a much heavier particle, the negative mu meson. Because the mu is 210 times heavier than an electron, it circles the nucleus at only 1/210 of the distance of an electron, and thus binds the two nuclei correspondingly closer. The nuclei then have a good chance of touching, and the nuclear reaction can take place.

The reaction is termed a catalyzed reaction because the mu meson is not consumed by the reaction but may be ejected from the molecule by the energy released. The mu is then free to catalyze more reactions, in chain fashion.

It is however emphasized that at the present time the energy producing chain of catalyzed reactions cannot continue long enough to generate commercially useful amounts of power, because mu mesons decay into other particles after two-millionths of a second. Unfortunately, from the point of view of thermonuclear power mu mesons can be made only in high-energy nuclear collisions of particles accelerated by cyclotrons and other expensive machines. But the possibilities will be greater if a much longer lived particle, with properties similar to that of the mu meson, can be found.

NEW USES FOR ATOMIC WASTE PRODUCTS

ATOMIC waste products produced in reactors by the fission or rupture of atoms of uranium or plutonium, are the nuclear scientist's nightmare. They are highly radioactive, therefore dangerous, and their disposal raises a serious problem. Some specialists have suggested that these materials be sunk into blocks of concrete and dropped into the deepest parts of the ocean. Others have even put forward the somewhat far-fetched idea of sending them out into space by rocket.

But this can hardly be the right approach to the problem. The question is not so much how to get rid of atomic waste products as to find a way of putting them to good use. The possibility of using them in industry was envisaged as early as 1951 by physicists at Stanford University in the United States. The idea was enlarged upon by Sir John Cockcroft during last year's British Conference on Radiology, with special emphasis on the polymerization of plastics.

Polyethylene is one of the most widely used among plastics, and it has been shown that gamma rays emitted by atomic waste products are powerful agents of polymerization. Sir John Cockcroft has calculated that only 100 curies of radioactivity are necessary to produce one ton of polyethylene from ethylene. This is very little, when one considers that by 1965, two tons of radioactive waste—that is, millions and millions of curies—will be produced in the United Kingdom alone. And the process would be extremely economical. Sir John Cockcroft has predicted that the cost of the energy involved in the production of one pound of plastic would amount to only one penny.

Meanwhile, research on other forms of polymerization is being pursued in Britain, while in France two physicists, Michel Magat and Auguste Chapiro, have succeeded in producing what they call "grafts" of plastics. They subject two different materials to gamma rays and thus obtain a third type of plastic through copolymerization.

In the 19th century, when electricity was

invented, it was found to be a very effective agent for initiating certain reactions. Later, as intense sources of artificial light came to be developed, it was discovered that light too could induce chemical changes. And today, nuclear energy provides a powerful medium for producing new chemical substances. Thus, after thermo-chemistry, electrochemistry and photo-chemistry, the science of radio-chemistry is being born.

The tremendous field which this new science is opening up has barely been explored to date. Scarcely a month passes without some new discovery being made. One of the most interesting was recently described in an article by Professor Hardeck in *Nucleonics*. It explains how fertilizers can now be produced from air in an atomic reactor.

The process is quite simple: when air is passed through an atomic pile, a large proportion of the energy resulting from the fission of uranium is converted into chemical energy, so that the nitrogen of the air combines with the oxygen of the air to produce nitric oxide, from which nitrate is manufactured. The fertilizer produced by this process has a low radioactive content and can safely be used and even stored for long periods.

Quite recently, radioactive "waste" recovered from atomic piles is being put to large-scale use in British hospitals for treatment of deep-seated cancer. The Royal Marsden Hospital, London, uses a source of radioactivity consisting of caesium produced from the fission products of the atomic piles at Windscale Works, in Cumberland, and has installed it in a specially designed therapy apparatus at Sutton in Surrey, for treatment of patients almost immediately.

Although the caesium itself, in the form of a salt of the element, is only the size of about four lumps of sugar, it has an activity of more than 1,200 curies. One may indeed hope that caesium units will in the not distant future make the best type of radiative treatment available for fighting the cancer.

CHEMICAL ELEMENTS BEYOND 92*

ESSENTIALLY all the elements heavier than uranium, element 92, are non-existent in nature. Such elements may have existed at

the birth of the earth, but they were all highly radioactive; as a consequence, they decayed turning into lighter elements and became extinct.

In 1940, Dr. E. M. McMillan and Dr. P. H. Abelson, using the Berkeley 60-inch cyclotron, created element 93. This was followed a year

* From a lecture by Dr. Glenn T. Seaborg at the Radiation Laboratory of the University of California, Berkeley.

later by plutonium, the nuclear energy fuel, discovered by Dr. Seaborg and his colleagues. Over the years most of the other elements were created in the same cyclotron, climaxing in 1955 with the discovery of element 101. Elements 99 and 100 were first detected in the debris of the first hydrogen bomb explosion in the Pacific.

The stable building material for all the new elements is uranium, element 92. As heavier and heavier elements are made, the elements are more and more radioactive; so they decay more and more quickly. Moreover, fewer atoms of the very heavy elements can be made. For example, in the case of element 101, only 17 atoms were detected in the experiments in which they were discovered—a quantity of matter that needs special devices for its detection and identification.

The chief method of making new trans-uranium elements in the past has been to propel particles—usually alpha particles—from the 60-inch cyclotron into heavy nuclei. For example, alpha particles added to element 99 gave atoms of element 101. Experiments have also been done in which heavy nuclei, e.g., carbon and nitrogen nuclei added to uranium atoms resulted in the production of these transuranium element.

The Berkeley cyclotron, however, does not accelerate particles as heavy as nitrogen in large enough quantities. Moreover, it is desirable to accelerate even heavier nuclei. This

is why, the new type "heavy ion linear accelerator"—the "Hilac"—is under construction, in the Radiation Laboratory at Berkeley. This machine, now nearing completion, will accelerate nuclei as heavy as neon and argon, the latter having an atomic weight of 40 as compared with the alpha particle's 4.

It is hoped that it will be possible eventually to make isotopes of elements up through 105 that can be identified by means of both their chemical and radioactive properties. This may take as long as five or ten years, and it will be necessary to rely upon unusual isotopes. Most of the isotopes of element 102 will be too short-lived—as short as a second—to identify. But there are some unusual isotopes with an odd number of neutrons that will have half-lives as long as minutes, and it is upon the creation of these that further ascent on the scale will be made possible.

After element 105, it is expected that the half-lives of the elements will become too short to allow the few minutes needed for chemical identification. Even so, it should be possible many years in the future to identify elements above 105 by means of their characteristic radioactivity, which can be predicted. Dr. Seaborg has predicted that elements 102 to 108 will be chemically similar to elements 70 to 76 respectively. The properties of the elements can be predicted even up to element 118, but by present methods it may not be possible to identify such elements beyond 108.

HEART-LUNG MACHINES

PROGRESS in the development and application of the mechanical pump-oxygenator or artificial heart-lung apparatus continues, and experience with its use in the human subject is being gained, principally as an aid to open cardiac surgery. Most reports have come from the United States, where many machines are in use and where an appreciable number of human operations have been reported, as well as innumerable animal experiments.

The pumps replace the heart and the oxygenator the lungs. In Melrose's apparatus the pumps are soft plastic tubes which are squeezed between metal plates with an undulating motion. This is imparted by cams, which are shaped so as to imitate the time intervals of the heart with a filling period longer than the ejection period. The speed and stroke volume can be varied as necessary. Valves which open for appropriate periods ensure flow in the right direction. Other machines have different

pumps, but the principle of pressure on soft tubing is usually invoked because it causes less haemolysis than other forms of pump. The venous pumps withdraw blood from cannulae in the great veins and from the interior of the right atrium, and pass it to the oxygenator.

It seems likely that in the near future the artificial heart-lung machine will allow certain cardiac operations to be carried out which at present are not feasible. These include the complete correction of Fallot's tetralogy—one of the commonest congenital lesions, which present operations either add to (Blalock's operation) or partially correct (pulmonary valvotomy); the repair of other forms of ventricular septal defect and of certain atrial septal defects; and perhaps the correction of the less common abnormalities such as transposition of the great vessels. Open cardiectomy offers greater promise for the repair of incompetent rheumatic valves than present techniques.

LETTERS TO THE EDITOR

	PAGE		PAGE
Spectrographic Analysis of Micro-Elements in Citrus Leaves—C. DAKSHINAMURTI AND N. R. DATTA BISWAS ..	110	Chromosome Number of Some Common Plants—M. R. AHUJA AND A. T. NATARAJAN ..	117
Determination of Iron in Tube-Well (Underground) Water—S. N. MITRA AND P. B. SARKAR ..	111	A New Species of <i>Pyrenochaeta</i> from Sugarcane in India—T. S. VISWANATHAN ..	117
Flies Visiting Lac Insects—S. MAHDIHASSAN ..	112	Meiosis in <i>Cephalotaxus drupacea</i> var. <i>pedunculata</i> —T. N. KHOSHOO ..	118
Occurrence of <i>Martesia striata</i> L. in Compact Clay in the Krishna Estuary Region—KANDULA PAMPAPATHI RAO, V. S. R. MURTHY AND A. KRISHNAKUMARAN ..	113	An Amphidiploid <i>Nicotiana glutinosa</i> L. × <i>Nicotiana trigonophylla</i> Dun. Hybrid—K. V. KRISHNAMOORTHY AND N. R. BHAT ..	120
Tables for S.N.F. of Buffalo Milk—B. C. LIMDI AND S. S. BHATT ..	113	Secondary Growth in the Petioles of the Leaves of Deciduous Plants and the Partial Shoot Theory of the Leaf—B. SAMANTARAI AND T. KABI ..	120
Pistil-less Off-Type Plants in Bajra (<i>Pennisetum typhoides</i> Stapf and Hubbard)—S. M. SIKKA, S. P. MITAL AND A. B. JOSHI ..	114	A Synthetic Allohexaploid in Arachis—L. S. S. KUMAR, R. D'CRUZ AND J. G. OKE ..	121
First Record of the White Grub <i>Lachnosteria consanguinea</i> Blanch. in Sugarcane in India—B. D. GUPTA AND P. N. AVASTHY ..	114	Occurrence of Tetigella spectra (Distant): Cicadellidae, Homoptera on Sugarcane in Mysore—K. S. SIVASHANKARA SASTRY ..	122
Ergot on Bajri [<i>Pennisetum typhoides</i> (Burm.) Stapf and Hubbard] in Bombay State—V. P. BHIDE AND R. K. HEGDE ..	116	Isolation and Estimation of Fenchone in Essential Oils as Thiourea Complex—T. MADHAVA MENON AND T. C. K. MENON ..	123
Use of Growth Inhibitors in Maintaining High Sugar Recoveries in Late Season—M. S. SUBBA RAO, M. S. HAQUE, R. B. PRASAD AND K. L. KHANNA ..	116	A New Species of <i>Parmelia</i> from Kodakanal, South India—D. D. AWASTHI ..	123
		Chromosome Number and Sex Mechanism in Twenty Species of the Indian Heteroptera—RAM PARSHAD ..	125
		A Key to the Identification of Impregnated Eggs of Common Fresh-Water Fishes of Bengal—S. R. MAZUMDAR ..	125

SPECTROGRAPHIC ANALYSIS OF
MICRO-ELEMENTS IN CITRUS
LEAVES

COPPER ARC method of analysis of soils for micro-element contents¹ was reported earlier from this laboratory, and in this paper a method is worked out for the analysis of boron, manganese and zinc in citrus leaf samples.

The average major element composition of healthy citrus leaves was taken from Chapman's analysis.² Synthetic citrus ash with percentage composition CaCO_3 77.4; K_2CO_3 6.5; MgSO_4 6.3; KH_2PO_4 3.8; SiO_2 2.7; MgO 1.2; Fe_2O_3 1.1; Na_2CO_3 0.9 was prepared from specpure chemicals obtained from Johnson Matthey and Co. Graded matrices of synthetic ash-micro-element mixtures were prepared to contain micro-element contents varying between 10,000 p.p.m.; and 10 p.p.m. 20 mg. of each standard mixture was mixed with an equivalent amount of aluminium oxide to which

1.09% of bismuth and 1.86% of cadmium were added as internal standards. Copper rods, J.M. 5.0 mm. diameter, were shaped at the top into 2.5 mm. diameter and a cavity of 1/16 inch diameter and 3 mm. depth was made in it. The samples were filled into the cavities of the copper electrodes (cathodes) and were arced at 5 amperes current using 220 volts D.C. The anode was a 5 mm. diameter copper rod and the length of the arc column was maintained at 2.7 mm. throughout the course of the arcing.

Stepped spectra were recorded on Ilford Chromatic plates using Hilger Automatic Large Quartz Spectrograph. Conditions of development and the measurement of intensities remained the same as were reported earlier. Proper background corrections were made using Seidel transformation for blackening curves.³ The detection limits of boron, manganese and zinc were found to be 1, 5 and

100 p.p.m. respectively. Recoveries of micro-elements added to the synthetic citrus ash are given in Table I and the wavelengths of the spectral lines used for estimation are given in parentheses.

TABLE I
Recovery of the micro-elements added to the synthetic soil

Micro-element	Internal Standard	Content of micro-element in p.p.m.	
		Added	Measured
B (2497.7 Å) .. W (2898.0 Å)		300	316
		175	199.5
		45	47.8
Mn (2794.8 Å) .. Bi (2898.0 Å)		300	275
		750	794.3
		45	41.3

Manganese contents of citrus leaves estimated both by chemical and spectrographic methods are given in Table II.

TABLE II
Comparison of chemical and spectrographic methods of estimation of manganese in citrus leaves

Sample No.		Mn in p.p.m. on dry matter basis obtained by	
		Spectrographic method	Chemical method
1	Santra ..	21.3	24.7
2	Santra ..	18.5	17.8
3	Grape fruit ..	40.3	42.5
4	Grape fruit ..	40.2	37.5
5	Grape fruit ..	28.0	30.5
6	Grape fruit ..	28.9	31.5

In the case of soils, zinc could be detected down to 50 p.p.m., but with CaCO_3 base of the citrus ash, zinc could not be detected below 100 p.p.m. Analysis of a number of citrus leaf samples collected indicated that their zinc content was mostly of the order of its detection limit by the spectrographic method.

Indian Agric. Res. C. DAKSHINAMURTI.
Institute, N. R. DATTA BISWAS.
New Delhi-12, December 16, 1956.

1. Meht, S. C. and Dakshinamurti, C., *Curr. Sci.*, 1955, 24, 409.
2. Chapman, H. D., *California Citrograph*, 1954-55, p. 518.
3. Black, I. A., *Spectrochimica Acta*, 1952, 4, 519.

DETERMINATION OF IRON IN TUBE-WELL (UNDERGROUND) WATER

Certain tube-well waters, clear when freshly drawn, become opalescent on standing due to the precipitation of iron as ferric hydroxide. The iron thus deposited usually sticks fast to the side of the bottle and is not dislodged even when the water is well shaken before withdrawing aliquots for analysis. This is more so particularly if the analysis is started after a fairly long interval after collection. Particularly in iron-rich underground waters, sufficient iron gets precipitated in this period.

It has been observed that estimation of iron in the water only, in such cases, does not give the true picture of the original iron content of the sample. To determine the true iron contents of such waters, the following modified procedure has been devised by the authors.

(i) The volume of water collected for analysis is measured. (ii) The iron content of the well-shaken water is determined in the usual manner by the colorimetric thiocyanate method.¹ Other usual routine determinations are also completed. (iii) Then, the bottle is completely emptied and lightly (avoiding violent shaking) washed with a little distilled water which is rejected. About 5 ml. of hot dilute HCl (1:1) are poured into the bottle which is slowly rotated and inverted several times to dissolve all the deposited iron completely in the acid. The solution is then poured into a beaker, the bottle washed a few times with a little distilled water and the washings are added to the main iron solution. The solution is boiled with a little conc. nitric acid and iron estimated in the solution by the thiocyanate method. The iron found in the deposit is calculated in terms of parts per 100,000 of the sample of water, the original volume of sample from which the deposit is obtained being already known. This result is added to the iron content of the water determined earlier. (iv) The total gives the true original iron content of the sample.

From several determinations it has been noted that if the deposited iron is not accounted for in the above manner, the percentage error in the estimation of the true original iron content may range from 9 to anything up to 52.

Also, experiments have shown that the agreement between the figure for iron content of freshly drawn tube-well water (in which no deposition has yet occurred) and the result obtained by the authors' method with the same water when it has been allowed to settle and

form deposit, is close. This is shown by the figures in Table I.

TABLE I

Sample No.	Iron found in freshly drawn tube-well water (as Fe, p.p. 100,000)	Iron found in the settled water (as Fe, p.p. 100,000)	Iron in the deposit (as Fe, p.p. 100,000 of the sample)	Calculated value of the original iron content of the sample (as Fe, p.p. 100,000) (Authors' method)	Period of settling (days)
1	0.20	0.09	0.10	0.19	6
2	0.54	0.45	0.03	0.53	2
3	0.56	0.40	0.14	0.54	3
4	0.35	0.32	0.03	0.35	2

The work is of great importance in studying the deposition of iron from tube-well waters in pipe lines. A serious underestimate may be made if the true iron content of the water is not known.

West Bengal Public
Health Lab.,

S. N. MITRA.

P. B. SARKAR.

School of Tropical Medicine,
Calcutta-12, February 4, 1957.

I. Taylor, E. W., "Examination of Waters and Water Supplies," Teresh, Beale and Sucking, 1949, Churchill, London, 6th. Ed., p. 240.

FLIES VISITING LAC INSECTS

IN respect of a study of how natural infection of lac is caused, records are few, if not altogether non-existent, particularly in the case of trees in thick forests. As a former visitor to the Traveller's Bungalow at Daltonganj, Palamau District, Bihar, I could see, at the time, almost a sea of *Butea frondosa* trees stretched out before me. The nearest weed was a seedling of this species and the farthest tree the eye could spot was the same species full grown. It was an ideal forest of pure *Butea frondosa*. Yet no lac was found there as far as I could see in my search. As distinct from a thick jungle, the outskirts may show natural infection. The chances are greater, when the host plants are dotted far apart all over an open forest and even more so when planted as avenue trees, with greater open space on either side, in front and in the row behind. A thick forest induces the formation of a long trunk and a huge canopy, well suited for timber production; but not for lac infection.

Conditions favouring fruit production produce the right predisposition for lac growth. It is well known that silviculture and horticulture

induce different physiological activities on the part of the tree and a thick forest is less conducive for lac production. Further it has been indirectly shown (1) that a water-soluble gum can feed the lac insects, and gummosis as a disease can be easily caused by the nitrogen-fixing bacteria, symbiotic with a leguminous tree, of which *Butea frondosa* is a good example. Now conditions, where the tree shows a stunted growth, maintain a balance disfavoured cellulose production; but where the tree is pruned to excess or even lopped heavily, they induce gummosis and are independently known to produce lac. Again it may be emphasized that a pure forest of *Butea frondosa*, as at Daltonganj, would offer little scope to any one trying to put every tree or even a few trees there under lac cultivation, as they are physiologically not predisposed to receive infection.

Now there is another aspect of the problem, which independently shows why an open forest alone should show more of the natural infection of lac. It is the question of the carrier which transports the larvae from tree to tree. Wind has been naively supposed to be such an agent, but it is very ordinary experience to find only one of the trees bearing lac, with the rest in a whole row of similarly situated trees a long avenue completely free from it. It is strange that no study has so far been undertaken of insects visiting lac. The secretion is a honey-dew, which often accumulates and even ferments; the growth of sooty mould may be so thick as to form a felt-like covering sometimes killing the lac insects beneath. That micro-organisms fermenting the honey-dew can produce compounds which can attract flies is natural to assume. In fact, honey-dew itself is a product of the symbiotic yeast within the body of the lac insect. It is proposed to make a study of the common insects which are attracted to lac and particularly those which are seen when larvae are swarming. The following insects were found as frequent visitors and have been kindly identified by Dr. Van Emden of the British Museum of Natural History. This study is being continued and further reports will follow.

Hymenoptera.—(i) Sphegidae (Crabronidae), a hymenopterous insect not reared from lac but a frequent visitor to it. (ii) *Brachymeria fulvipes* Cameron, a chalcid not reared from lac but a frequent visitor to it. (iii) The honey-bee did not visit lac experimentally grown. It used to do so at Bangalore where it was grown commercially.

Diptera.—Calliphoridae—*Sarcophaga hirtipes* Wied; *Chrysomya albiceps* Wied, Muscidae:

on the *Gymnodia tonitru* Wied, *Gymnodia tonitru* ab.
canache Walk; Trypetidae—*Tephrostola rein-*
hardi Wied; Otitidae: *Chrysomya aenea* F.,
Chrysomya demandata F.; Milichiidae—*Milichia*
pubescens Beck, *Milichiella lacetipennis* Loew;
Ephydriidae—*Gymnopa albipennis* Loew.

Biochemistry Division, S. MAHDIHASSAN.
Council of Scientific Research,
Pakistan, Karachi,
April 11, 1956.

1. Sreenivasaya, M. and Mahdihassan, S., *J. Indian Inst. Sci.*, 1929, 12 A, 69.

OCURRENCE OF *MARTESIA STRIATA* L. IN COMPACT CLAY IN THE KRISHNA ESTUARY REGION

Martesia striata L. is typically known to occur
in wood¹ into which it bores, presumably for
protection. Besides occurring in wood, it has
also been recorded boring into argillaceous
limestone,² madrepores³ and even in brick-
work.^{4,5} It is hence commonly believed that,
since *Martesia* is a boring mollusc, it needs a
relatively hard and stable substratum into which
it could bore for shelter.

During the course of an extensive hydro-
biological survey of the Krishna River Estu-
ary, we have found on either side of the mouth
of the river, large areas of compact, but very
soft clay. The surface of the clay appeared
riddled with holes at low tide, when the whole
area was exposed. On examination, each of
these openings harboured an individual *Mar-*
tesia striata. They occur in very large num-
bers. We have been able to count nearly 1000
bore-holes in an area of about one foot square
or 1000 square centimeters.

We have collected these specimens of
M. striata from the same locality during two
different seasons, the first time in April and
a second time in September. On the first occa-
sion the individuals were relatively small, the
largest measuring not more than 8 or 10 mm.
in shell length. The salinity of the water was
relatively higher, since the discharge from the
river into the sea is near its minimal at this
time of the year. But in September we were
able to collect from the same bed much larger
specimens on the average and the largest
specimens now collected measured 20 mm. in
shell length. At the time of this second collec-
tion, the river was in full flood and the dis-
charge from the river into the sea was at its
greatest. Hence the salinity was nearly at its
lowest. Since on both the occasions, collections

were made from the same bed, the difference
in size of individuals might represent the
growth during the six months from April to
September. Further it shows that the occur-
rence of *M. striata* in this environment is regu-
lar and perhaps permanent and not a chance
event.

It is known that *Martesia* varies in form
according to the nature of the substratum into
which it is boring.⁶ Since the estuarine clay
is the softest of the substrata from which *Mar-*
tesia has been recorded so far, we may reason-
ably expect it to show some differences from
specimens recorded from other harder sub-
strata. A fuller account of such aspects of its
biology will be published elsewhere.

Dept. of Zoology, KANDULA PAMPAPATHI RAO.
Sri Venkateswara V. S. R. MURTHY.

University, A. KRISHNAKUMARAN.
Tirupati, October 10, 1956.

1. Calman, W. T. and Crawford, G. I., *Brit. Mus. (Nat. Hist.) Econ. Ser.*, 1936, 10, 1-38.
2. Blanford, W. T., *J. Asiat. Soc. Beng.*, 1867, 36, 51.
3. Jousseume, F., *Naturaliste*, 1891, 2 Ser., 106, 183.
4. Anandale, N., *J. Asiat. Soc. Beng.*, 1923, 18, 555.
5. McGlashan, J., *Rep. Comm. Inst. Civil Engineers*, 1924, 4, 59.
6. Purchon, R. D., *Proc. Zool. Soc. London*, 1956, 126, 245.

TABLES FOR S.N.F. OF BUFFALO MILK

With the advent of the Prevention of Food
Adulteration Act, public analysts and dairy
chemists will have to deal with an increasing
number of milk samples also. Richmond's
formula for buffalo milk,¹

$$T = 0.27 \frac{G}{D} + 1.191 F$$

can be applied for finding out the Solids-Not-
Fat of milk as a routine method. In order to
avoid the waste of time taken during each
calculation, a table based on the above for-
mula has been prepared, from which S.N.F. of
buffalo milk can be directly read with fair
accuracy.

In Table I, the five horizontal lines on top
represent lactometer readings at 60° F. with
corrections for S.N.F. The lower portion shows
the S.N.F. for various fat percentages. The
fractional percentages of fat require additions
which are shown in the two columns on the
right side.

Thus, for a milk with a lactometer reading
at 60° F. of 33.5 containing 6.7% fat, the
horizontal reading corresponding to 33.5 is

TABLE I

Lactometer reading at 60° F.	12.0	12.5	13.0	13.5	14.0	14.5	15.0	15.5	16.0	16.5	17.0	17.5	Corrections	
	18.0	18.5	19.0	19.5	20.0	20.5	21.0	21.5	22.0	22.5	23.0	23.5	- 3.10	
	24.0	24.5	25.0	25.5	26.0	26.5	27.0	27.5	28.0	28.5	29.0	29.5	- 1.55	
	30.0	30.5	31.0	31.5	32.0	32.5	33.0	33.5	34.0	34.5	35.0	35.5	0.00	
	36.0	36.5	37.0	37.5	38.0	38.5	39.0	39.5	40.0	40.5	41.0	41.5	+ 1.50	
													+ 3.05	

Fat %														Fat (fractional %)	Addition
0.0	6.33	6.46	6.59	6.71	6.84	6.97	7.10	7.23	7.36	7.48	7.61	7.74	7.87		
1.0	6.62	6.65	6.78	6.91	7.03	7.16	7.29	7.42	7.55	7.67	7.80	7.93	8.06	0.1	-0.2
2.0	6.71	6.84	6.97	7.10	7.23	7.35	7.48	7.61	7.74	7.87	7.99	8.12	8.25	0.2	-0.4
3.0	6.90	7.03	7.16	7.29	7.42	7.54	7.67	7.80	7.93	8.06	8.18	8.31	8.44	0.3	-0.6
4.0	7.09	7.22	7.35	7.48	7.61	7.74	7.86	7.99	8.12	8.25	8.38	8.50	8.63	0.4	-0.8
5.0	7.28	7.41	7.54	7.67	7.80	7.93	8.06	8.18	8.31	8.44	8.57	8.69	8.82	0.5	-0.9
6.0	7.47	7.60	7.73	7.86	7.99	8.12	8.25	8.37	8.50	8.63	8.76	8.88	9.01	0.6	-1.1
7.0	7.66	7.79	7.92	8.05	8.18	8.31	8.44	8.57	8.69	8.82	8.95	9.07	9.20	0.7	-1.3
8.0	7.86	7.98	8.11	8.24	8.37	8.50	8.63	8.76	8.88	9.01	9.14	9.27	9.40	0.8	-1.5
9.0	8.05	8.18	8.30	8.43	8.56	8.69	8.82	8.95	9.08	9.20	9.33	9.46	9.59	0.9	-1.7
10.0	8.24	8.37	8.50	8.62	8.75	8.88	9.01	9.14	9.27	9.39	9.52	9.65	9.78		

+1.50; the vertical reading corresponding to 33.5 for 6.0% fat is 8.37, and for 0.7% fat the corresponding addition from the side columns is 0.13. Therefore, the S.N.F. for this milk is $1.50 + 8.37 + 0.13 = 10.00\%$. Similarly, for a milk with a lactometer reading of 16.0 at 60° F. containing 3.0% fat, the S.N.F. would be $7.93 - 3.10 = 4.83\%$.

The authors are grateful to Dr. S. T. Pandya for his active interest and encouragement.

Public Health Lab., B. C. LIMDI.
Surat Borough Municipality, S. S. BHATT.
Surat, February 25, 1957.

1. Richmonds, H. D., *Dairy Chemistry*, Revised by J. G. Davis and F. J. Macdonald, Griffin & Co., London, 1953, 5th ed., p. 96.

PISTIL-LESS OFF-TYPE PLANTS IN BAJRA (*Pennisetum typhoides* STAPF AND HUBBARD)

THE ear of bajra (*Pennisetum typhoides* Stapf & Hubbard) is a dense spike-like panicle comprising spikelets in groups of 1 to 4, usually 2. In each spikelet there are two florets; the lower is normally staminate and the upper perfect.

In the bajra collection grown for study in this Division during the kharif of 1955, two abnormal plants were noticed—one in each of the cultures, Delhi Local and I.C. 2592 (Jamnagar Giant, ex Saurashtra). These abnormal plants were somewhat shorter than their sister plants and their ears were also shorter than

those of the normals. In the ears of these plants, all the florets, which normally should be perfect, were found to be staminate, the pistils being totally absent. The stamens produced abundant pollen grains which, on iodine test, were found to be well-formed and full of contents. By dusting this pollen on to the stigmas of sister plants, a good amount of seed has been obtained. The mode of inheritance of this character will be studied during the following years.

So far as we are aware, pistil-less plants in bajra have not been reported in the literature.

Division of Botany, S. M. SIKKA.
Indian Agric. S. P. MITAL.
Res. Inst., A. B. JOSHI.
New Delhi, November 26, 1956.

FIRST RECORD OF THE WHITE GRUB *LACHNOSTERNA CONSANGUINEA* BLANCH. IN SUGARCANE IN INDIA

THE roots of the sugarcane crop have long been known to be liable to damage by beetle grubs in Australia, Mauritius and other sugarcane-growing countries. In India, although a number of species of grubs have been recorded from sugarcane, none has been noted to cause extensive damage. It was for the first time in late August 1956 that white grubs, belonging to the Cockchafer family (*Melolonthidae*) were observed to be the cause of a large-scale drying up of the sugarcane crop at the factory farm of M/s. Rohtas Industries, Ltd., Dalmianagar (Bihar). It would appear that

the climatic conditions during the period June-July 1956 favoured the activity of the grubs. The rains started much earlier than usual; but the area suffered from prolonged drought from the middle of June to the second week of July. The phenomenon of yellowing of the leaves even after heavy irrigations in July prompted a further probing into the matter, and as a result of digging, beetle grubs were observed in the root zone of the crop lying between 6-8 inches of the soil.

The grubs were observed to feed on rootlets and root-hairs in such a manner that the entire root system was cut off (Fig. 1). The

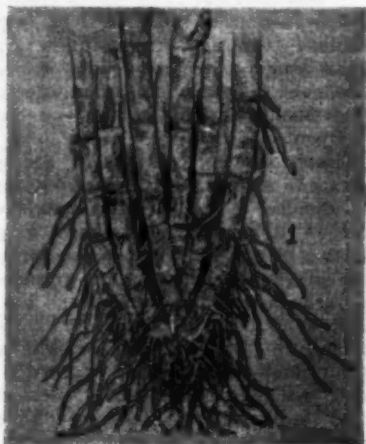


FIG. 1 Showing roots devoid of rootlets and root-hairs.

grubs did not feed on the main roots nor did they damage the stalk. As a result of injury, the main roots turned black and stopped functioning and the clump developed symptoms of withering. The outer leaves dried up first and the attacked clump was noticed to come off the ground at the slightest pull. Heavily infested fields showed patchy growth with an uneven stand of canes.

From 6 to 8 grubs were met with under a clump in heavily infested areas in September; but by the third week of October, with the lowering of the temperature, the grubs were observed to have migrated downwards. A search for the pest in infested areas revealed its presence in grub, pupa and adult stages between 1-4 ft. below ground level. They were lying dormant in small cells carved out by them in the soil, irrespective of the cane rows or the presence of the clumps above. The grubs were also found in fields prepared for the autumn planting of sugarcane, and could

be collected in various stages of their development. However, the pest was mostly in the pupal and adult stages (Figs. 2-4).



FIGS. 2-4. 2, grub; 3, pupa; 4, adult beetle.

The damage was severe in crops growing on light sandy soils, although the grubs could be collected from other soil types also. This observation was further confirmed by the serious infestation noticed on sandy soils at Gobardhanpur farm in the neighbourhood and also at Sikaria farm a few miles away from Dalmianagar on the Rohtasgarh road.

Kans (*Saccharum spontaneum*) growing on the bunds and the borders of the cane fields as well as the pea-nut (*Arachis hypogaea*) were observed to harbour the grubs.

The grub is white and fleshy, with a curved-up body about 53 mm. long and 7 mm. broad at the thorax with brown head and three pairs of prominent legs. The skin of the abdominal segments being translucent, contents of the intestine are clearly visible from outside (Fig. 2). The pattern of the double row of spines on the ventral surface of the terminal abdominal segment shows that the insect is a *Melolonthine* or Cockchafer grub.

The pupa is of the exarate type, cream-coloured and remains in an earthen cell deep into the soil. The adult beetles possess cream-coloured abdomen with brown elytra and deep brown legs.

The insect has been identified as *Lachnosterna consanguinea* Blanch. by Dr. R. N. Mathur, Forest Entomologist, Dehra Dun.

Entom. Lab.,

Indian Inst. of Sugarcane

Res., Lucknow,

January 17, 1957.

B. D. GUPTA.

P. N. AVASTHY.

**ERGOT ON BAJRI [*Pennisetum
TYPHOIDES* (BURM.) STAFF AND
HUBBARD] IN BOMBAY STATE**

ERGOT was recorded on bajri [*Pennisetum typhoides* (Burm.) S. & H.] for the first time in India in October 1956 in the South Satara and Kolhapur Districts of Bombay State and also in the Belgaum and Bijapur Districts, now included in Mysore State. The disease appeared in a severe form in late-sown crops and its incidence was as high as 25% in some fields. In the early or *Sphacelia* stage, the disease was characterised by the oozing out of a pinkish sugary substance from affected flowers on the earheads. This secretion sometimes drops on the leaves and dries there. Ants and other insects are attracted by this secretion and help in disseminating the disease. Later in the season, affected ovaries are transformed into dark brown, elongated sclerotia which take the place of normal grain. A few to many flowers are affected on an earhead, the rest maturing into normal grain. The sclerotia are hard, horny, with pointed ends, slightly bent in the middle and measure 3-5 mm. (Fig. 1). The

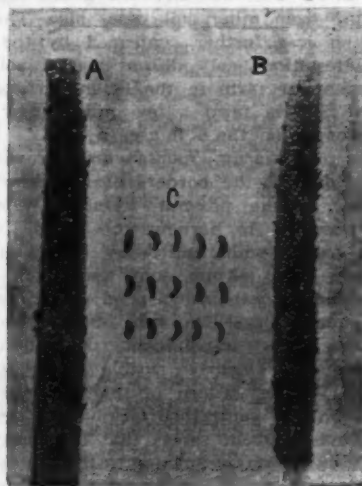


FIG. 1

conidia of the fungus in its *sphacelial* stage are hyaline, falcate and measure 20.7×6.1 ($16.3-24.6 \times 5.1-7.6$) microns.

In October 1955, only the *Sphacelia* stage was recorded in Banaskantha District but the incidence of the disease was low. The fungus has been isolated in pure culture from the *Sphacelia* stage of the fungus and has proved pathogenic to bajri on reinoculation. Ears thus inoculated artificially developed typical sclerotia of ergot.

Further work on the identification of the fungus by germination of sclerotia, resistance of different bajri varieties to the fungus and its hosts range and the estimation of ergotamine and ergotamine in the sclerotia is in progress.

Plant Path Lab.,
College of Agriculture,
Poona, February 4, 1957.

V. P. BRIDE.
R. K. HEGDE.

**USE OF GROWTH INHIBITORS IN
MAINTAINING HIGH SUGAR
RECOVERIES IN LATE SEASON**

MALEIC HYDRAZIDE or MH, as it is popularly known, has been one of those new synthetic chemicals which have come into varied use. It is believed to be an anti-auxin affecting the basic metabolism of all plants¹ and has been used to control growth of grasses so as to cut down costly mowing operations.² Storage life of potatoes, onions, carrots and turnips has been extended by pre-harvest sprays of this substance.³ It has also been shown to prevent breakdown of sugars in sugar beet during storage by preventing sprouting.^{4,5} Terpineol, another growth-retarding chemical, has been successfully utilised in prevention of sprouting in potatoes.^{6,7} Mathur and Srivastava⁸ used strips of filter-paper soaked in 1.5 c.c. of the chemical for each 25 lb. lots of potatoes. This resulted in considerable decrease of physiological losses in weight and sprouting habit, at all the storage temperatures investigated. Such being the case, it was considered worthwhile to try the two chemicals Maleic hydrazide and Terpineol on sugarcane to prevent breakdown of sucrose in late season when temperatures are on the increase.

Large-scale trials were laid out in sugar factory areas with treatments consisting of foliar sprays of the two chemicals at various concentrations varying between 100 and 700 p.p.m. applied at 60 gallons per acre. Varieties used were B.O. 11, B.O. 14, B.O. 17 and Co 419. Periodical milling tests were carried out at different periods ranging from 4 to 36 days after the spraying. Large-scale mill tests showed that in all cases, substantial increases in sugar recovery resulted from the treatment. The lowest concentration of 100 p.p.m. was more or less equally effective as the higher ones and time interval did not have a marked influence on the results. Likewise, there was no appreciable difference between the results obtained with the two chemicals. The range of improvement in per cent. re-

covery was 0.32 to 1.70 in case of MH and 0.73 to 1.70 in case of Terpineol. On an average, an improvement in recovery of the order of 0.86 unit is recorded. Further work is in progress.

Central Sugarcane Res. Station,
Pusa, Bihar,
February 4, 1957.

M. S. SUBBA RAO.
M. S. HAQUE.
R. B. PRASAD.
K. L. KHANNA.

1. Leopold, A. C. and Klein, W. H., *Science*, 1951, 114, 2.
2. Escritt, E. S., *J. Sports Turf Res. Inst.*, 1953, 8, 269.
3. Paterson, D., *Agrom. J.*, June 1953, 332.
4. Peto, F. J., et al., *Proc. Amer. Soc. Sugar Beet Tech. 9th General Meeting*, 1952, pp. 86, 90, 95, 101.
5. Ririe, D. and Mikkelsen, D. S., *Amer. Soc. Sugar Beet Tech.*, 1952, 4 (an abstract).
6. Edwards, G. R., *J. Dept. Agri. South. Australia*, 1953, 46, 131.
7. Emilsson, B., *Acta Agricultural Suecana*, 1949, 3, 270.
8. Mathur, P. B. and Srivastava, H. C., *Proc. 42nd Sci. Cong.*, Part III, Abstract, 43, 375.

CHROMOSOME NUMBER OF SOME COMMON PLANTS

THE chromosome numbers of some common plants belonging to families like Asclepiadaceæ, Rubiaceæ, etc., have not been reported so far, mainly because of the difficulties in getting good preparations due to cell inclusions, like latex, present in the tissues. Taking advantage of the squash technique and the use of various combinations of prefixing chemicals like paradichlorobenzene, colchicine, α -bromonaphthalene, oxyquinoline, etc., we report here the chromosome numbers of some plants (Table I) either grown in the Botany Division, Indian Agricultural Research Institute, New Delhi, or occurring in the nearby areas. The somatic counts were made from root-tip squashes stained with leucobasic fuchsin or aceto-orcein and the gametic counts were made from PMC smears using aceto- or propiocarmine.¹ These numbers are not listed in the recent edition of *Chromosome Atlas* by Darlington and Wylie² and hence are believed to be new counts. Of these, three numbers, i.e., *Calotropis*, *Dodonaea* and *Hamiltonia* are the first generic reports.

As evident from Table I, the chromosome numbers of *Justicia quinqueangularis*, *Heliotropium indicum*, *Cassia artemisoides*, *Jasminum pubescens* and *Hamiltonia sauveolens* were determined from the first metaphase configurations of the pollen mother cells. *J. quin-*

TABLE I

Species	Family	Chromosome No.	
		n	2n
<i>Justicia quinqueangularis</i> Koen.	Acanthaceæ	9	..
<i>Calotropis procera</i> R. Br.	Asclepiadaceæ	..	22
<i>C. gigantia</i> R. Br.	do	..	22
<i>Heliotropium indicum</i> Linn.	Boraginaceæ	32	..
<i>Kochia indica</i> Wight.	Chenopodiaceæ	..	18
<i>Cassia artemisoides</i> Gaudich.	Leguminosæ	28	..
<i>Rhynchosia aurea</i> DC.	do	..	22
<i>Jasminum pubescens</i> Willd.	Oleaceæ	..	39
<i>Hamiltonia sauveolens</i> Roxb.	Rubiaceæ	12	..
<i>Dodonaea viscosa</i> Jacq.	Sapindaceæ	..	32

queangularis ($2n=18$) characterised by the formation of nine bivalents appears to be a diploid. *H. indicum* ($2n=64$), in spite of a high number, was found to form 32 bivalents. *C. artemisoides* ($2n=56$) had a low frequency of multi- and uni-valents, the common configuration being $IV_1 + III_1 + II_{24} + I_1$. With a frequency of three to five trivalents, *Jasminum pubescens* ($2n=39$) appears to be a triploid. *Hamiltonia sauveolens* ($2n=24$) was found to form twelve bivalents. Of those plants, whose chromosome numbers were determined from the study of the somatic complements, both the species of *Calotropis* were indistinguishable from their karyotypes, each possessing a pair of satellited chromosomes.

We are grateful to Dr. S. M. Sikka for facilities.

Botany Division, Indian Agric. Res. Inst.,
New Delhi-12, January 3, 1957.

M. R. AHUJA.
A. T. NATARAJAN.

1. Swaminathan, M. S., Magoon, M. L. and Mehra, K. L., *Indian J. Genet. Pl. Breed.*, 1954, 14, 87.
2. Darlington, C. D. and Wylie, A. P., *Chromosome Atlas Flowering Plants*, 1955, George Allen and Unwin Ltd., London.

A NEW SPECIES OF PYRENOCHAETA FROM SUGARCANE IN INDIA

SPECIMENS of sugarcane leaves apparently showing *Cercospora* leaf-spot were received in the laboratory. On critical examination they were found to be infected with two fungi, which later were identified through the courtesy of Dr. E. W. Mason and Dr. Brown of the

Commonwealth Mycological Institute, Kew, as sp. of *Melanospora* and *Pyrenochaeta* respectively. The fungi were readily brought into pure culture, and since the latter appeared to be new to science, was studied in detail, and the results are presented here.

A comparison between the Indian species of *Pyrenochaeta* and *Pyrenochaeta sacchari* Bitancourt recorded from Brazil,¹ (given in Table I) would indicate that the Indian species is distinct in its morphological characters from *P. sacchari*, and accordingly it is presented here as a new species of *Pyrenochaeta*.

TABLE I
Comparison between Indian and Brazilian species of *Pyrenochaeta*

Species	Pycnidia	Ostiole	Setae	Pycnidiospores
<i>P. sacchari</i>	50-100 μ	..	1-20 5-40 \times 2.5-5 μ	6-12 \times 3 μ
Indian sp.	30-190 μ	10-15 μ	1-50 5.0-71.0 \times 1.7-3.4 μ	3-6 \times 2.5 μ

Pyrenochaeta indica SPEC. NOV. VISWANATHAN

Foliorum maculae sordide brunneae, centro albo, fusiformes, 2-6 \times 1-3.5 mm., hypophyllae, corpusculis pycnidialibus alte nigris in centro. Pycnidia globularia vel ovoidea, 30-190 μ diam., ornata uno, raro pluribus ostioliis, setosa ad ore, superficialia. Setae fuscae brunneae, obtusae, numero 1 ad 50, circumscriptae circum ostiolum, 5.1-71.4 μ longae, vulgo septatae. Pycnidiosporae unicellulatae, hyalinae, sed fuscae in massa. 3-6 \times 2.5 μ (Fig. 1).

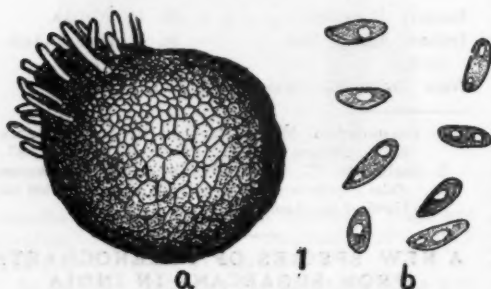


FIG. 1. *Pyrenochaeta indica*.—a. Pycnidium (\times 420), b. Pycnidiospores (\times 1,590).

Typus lectus in foliis *Sacchari officinarum* L. in loco Poona, in India a T. S. Viswanathan.

Type specimens have been deposited at the Commonwealth Mycological Institute, Kew,

England, and Herbarium Orientalis, New Delhi (India).

The author's thanks are due to Prof. M. N. Kamat under whose guidance this work was carried out, to Prof. E. W. Mason and Dr. Brown of the Commonwealth Mycological Institute, Kew, England, for many courtesies and helpful suggestions in identification and to Prof. Santapau for the Latin diagnosis.

T. S. VISWANATHAN.

Maharashtra Association
for the Cultivation of
Science, Poona, December: 16, 1956.

1. Bitancourt, A. A., *Arquivos do Instituto Biológico, São Paulo, Brazil*, 1938, 9, 301.

MEIOSIS IN *CEPHALOTAXUS*
DRUPACEA VAR. *PEDUNCULATA*

MEHRA AND KHOSHOO¹ observed 12 bivalents in the pollen mother cells of this variety. The present report is an extension of the same study. A meiotic irregularity was observed which, to the writer's knowledge, has not been recorded so far for any gymnosperm material.

The male cones were collected from the Forest Research Institute Arboretum (Dehra Dun) and were fixed in acetic-alcohol (1:3). Pollen mother cells were squashed in aceto-carmine.

The earliest stage available was a probable case of a prometaphase which revealed 12 bivalents each with 1-2 chiasmata. The same situation prevails at metaphase I except that the bivalents are more condensed (Fig. 1). After this stage in some trees there follows a perfect anaphase I and II resulting invariably in tetrad formation. The pollen appears to be normal. About 3% pollen is diploid.

However, in other trees only about 5% pollen mother cells show normal meiosis while in the remaining 95% cells the bivalents become highly contracted, terminalized and are irregularly distributed within the cells (Fig. 2). Evidently all these changes are caused by the lack of a directive influence of the spindle. Observations on 40 cells showed that the 12 bivalents were distributed in 22 different combinations. The maximum number of bivalents seen in a group was 12 which in course of time formed a single restitution nucleus. Metaphase I passes into anaphase I rather insensibly. The 24 univalents were distributed irregularly (Fig. 3) and 12 different arrange-

s, New

f. M. N.
ork was
r. Brown
nstitute,
d help-
and to
s.

ATHAN.

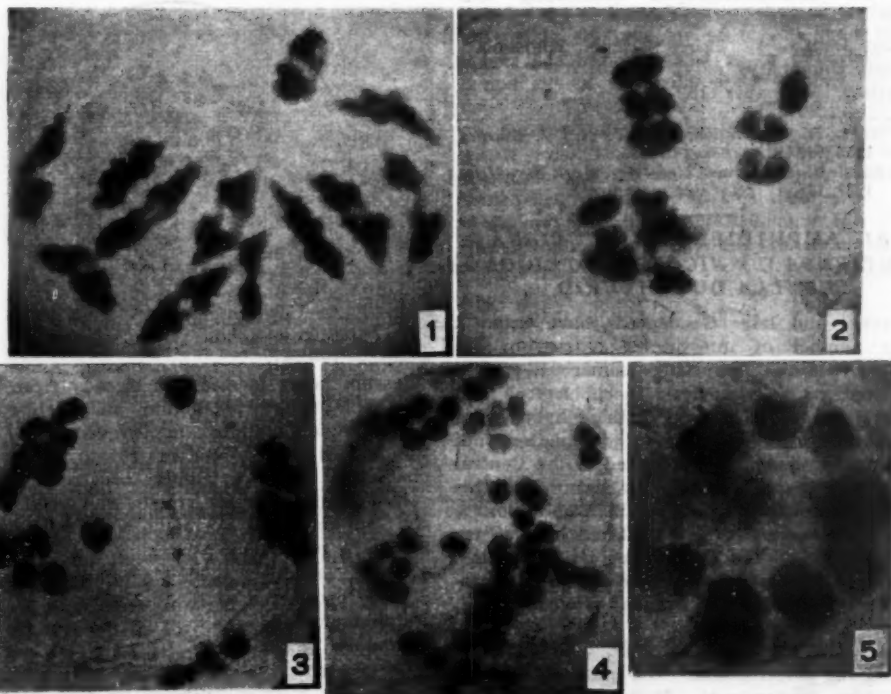
Biologico,

S
TA

ents in
t. The
e same
bserved
ot been
aterial.
m the
(Dehra
(1:3).
aceto-

probable
12 bi-
e same
ot that
g. 1).
lows a
ariably
to be

% pol-
nile in
become
irre-
g. 2).
by the
pindle.
he 12
com-
valents
se of
Meta-
nsen-
buted
ange-



FIGS. 1 to 5

Fig. 1. Twelve bivalents at metaphase I; Fig. 2. Abnormal metaphase I showing contracted and terminalized bivalents which are distributed in three groups; Fig. 3. Anaphase I showing 24 univalents distributed in 6 groups; Fig. 4. Anaphase II showing 48 chromatids which are irregularly distributed; Fig. 5. A polyad containing 10 microspores one of which is out of focus. All approx., $\times 1,500$.

ments were observed within 20 cells. At telophase I, 1-7 nuclei were organised. There was a tendency for forming two bigger nuclei when there were more than two nuclei in a cell. The next stage to be studied was anaphase II when 48 chromatids were irregularly distributed within the cell (Fig. 4). There were noted 39 different arrangements within 50 cells. In some cases all the 48 chromatids were in a single group which ultimately resulted in a monad. At telophase II 46.7% pollen mother cells contained tetrads with equal or unequal spores. Such spores may contain micronuclei also. The remaining 53.3% mother cells contained monads, diads, triads and polyads containing upto 10 spores (Fig. 5). The cell-wall formation appears to be by furrowing. Only 10% pollen appears to be good and the remaining being very variable in size and apparently sterile.

It can safely be concluded that this meiotic irregularity is due to the non-functioning of the spindle. That this aberration is not due to environmental causes is clear from the fact that trees with normal¹ and abnormal meiosis grow side by side. It is tempting to suggest that the cause is genic and ever since the findings of Beadle,² it has become increasingly clear that the spindle is under genic control. Further, since both the normal and abnormal divisional cycles occur side by side within the same microsporangium, it is reasonable to presume that the genic control is not dominant or specific. If it were so, it should have affected all the cells of microsporangium. A detailed account will appear elsewhere.

The author is indebted to Prof. P. N. Mehra for his keen interest and encouragement, to Mr. M. B. Raizada (Dehra Dun) for allowing the use of the material and to Mr. R. S. Pathania

for the microphotographs illustrating this paper.

Botany Dept., T. N. KHOSHOO.
Panjab University,
Amritsar, November 18, 1956.

1. Mehra, P. N. and Khoshoo, T. N., *J. Genetics*, 1956, **54**, 181.
2. Beadle, G. W., *Cornell Univ. Agr. Expt. Sta. Mem.*, 1931, **135**, 1 (Not seen in original).

AN AMPHIDIPOID *NICOTIANA GLUTINOSA* L. \times *NICOTIANA TRIGONOPHYLLA* DUN. HYBRID

KOSTOFF¹ and later Goodspeed² have listed a great number of interspecific crosses in the genus *Nicotiana*, involving numerous species combinations. Cytological, morphological and other characters of several of these hybrids are also on record. A few fresh combinations not so far listed have been produced at the Central Tobacco Research Institute, Rajahmundry. This note relates to an amphidiploid *N. glutinosa* \times *N. trigonophylla* hybrid established here so far as is known to the authors for the first time. The amphidiploid progeny was obtained by colchicine doubling of a branch in a sterile F_1 plant.

Like both the parents, the F_1 also possessed 24 somatic chromosomes. The *glutinosa* characters were predominant. Meiosis was irregular and pollen production was almost lacking. Colchicine in 1% aqueous concentration was applied to several of the axillary buds, but only one bud reacted to the alkaloid and the branch bore fertile capsules. From the seeds of such capsules vigorous F_2 (C_2) seedlings were obtained this year and a number of plants of this amphidiploid progeny is now under study. Their chromosome number 48 conforms to the amphidiploid nature of the hybrid (Fig. 1). The plants are robust and possess

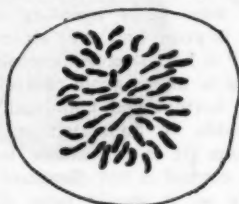


FIG. 1

more or less the F_1 morphological characters, with a slight increase in size of individual organs. Pollen production is very good. Meiotic number 24 was observed in several counts made in these plants (Fig. 2). Well-filled cap-

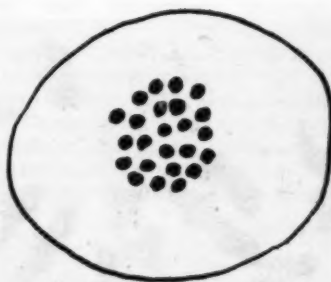


FIG. 2

Figs. 1 and 2. Somatic metaphase ($2n=48$) and meiotic metaphase ($n=24$).

sules are being formed and already from their seed a F_2 (C_2) population has been raised. Thus the amphidiploid has proved to be fertile and is under detailed study for various characters including disease resistance.

Due to its vigorous growth and good fertility, the amphidiploid might soon establish itself as a new stable species.

Central Tobacco Res. Inst., K. V. KRISHNAMOORTHY.
Rajahmundry, N. R. BHAT.
December 27, 1956.

1. Kostoff, D., *Cytogenetics of the Genus Nicotiana*, State Printing Press, Sofia.
2. Goodspeed, T. H., *The Genus Nicotiana*, Chronica Botanica Co., 1954.

SECONDARY GROWTH IN THE PETIOLES OF THE LEAVES OF DECIDUOUS PLANTS AND THE PARTIAL SHOOT THEORY OF THE LEAF

LEAVES of herbaceous plants, so far studied, do not show any secondary growth when attached to the plant, but when isolated and rooted by the application of synthetic hormones produce secondary growth in their petioles and veins.^{1,2} The investigation was extended to the examination of petioles of leaves of deciduous plants when they were attached to the plant. *Schleichera trijuga*, Willd. is a deciduous plant where well-formed secondary growth has been found in the petioles, when the leaves are attached to the plant. Fig. 1 represents a transverse section of the petiole of a young leaf of this species. It is seen that there are a large number of vascular bundles arranged in a triangular manner, with the base of the triangle towards the adaxial side of the petiole. Each vascular bundle is endarch and

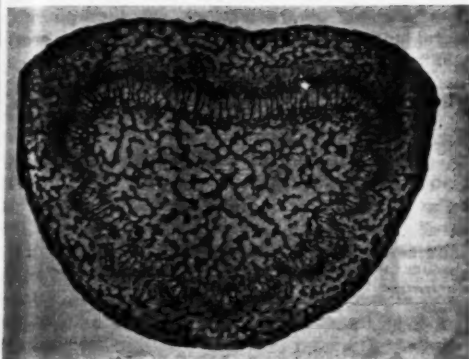


FIG. 1. Transverse section of the petiole of a young leaf of *Schleicheria trijuga*, Willd. Showing the primary structure.

collateral containing very rudimentary fascicular cambium. External to the phloem, there is a continuous sclerenchymatous zone which is wavy towards the abaxial side. The cells of the pith and the cortex are parenchymatous having deeply stained contents.

At a very mature stage, a transverse section as depicted in Fig. 2, shows a continuous

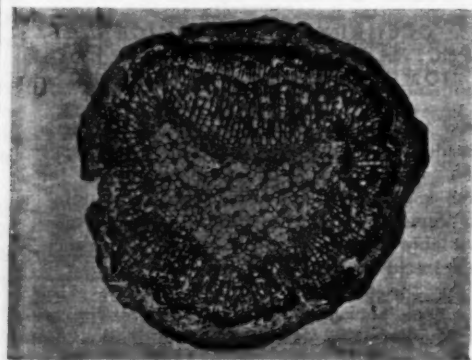


FIG. 2. Transverse section of the petiole of a mature leaf of *Schleicheria trijuga*, Willd. Showing advanced stage of secondary growth.

mass of xylem consisting of vessels and fibres. The secondary vascular tissue is produced by a continuous ring of cambium formed by the union of the subsequently developed interfascicular cambium and the pre-existing fascicular cambium. The triangular contour is still maintained. Secondary growth has also been discovered in the petioles of other deciduous plants like *Ficus religiosa*, L., and *Tectona grandis*, L. and some others.

Arber³ has discussed the morphological nature of the leaf. The presence of secondary growth in the petioles of isolated and rooted leaves has been adduced as an important evidence of her 'partial shoot theory of the leaf'.^{1,2} The occurrence of secondary growth in the petioles of the leaves of deciduous plants even when the leaves are attached to the plant and without any external treatment, lends further support to this theory.

We are thankful to our colleague Mr. C. M. Bastia for kindly taking the photomicrographs.

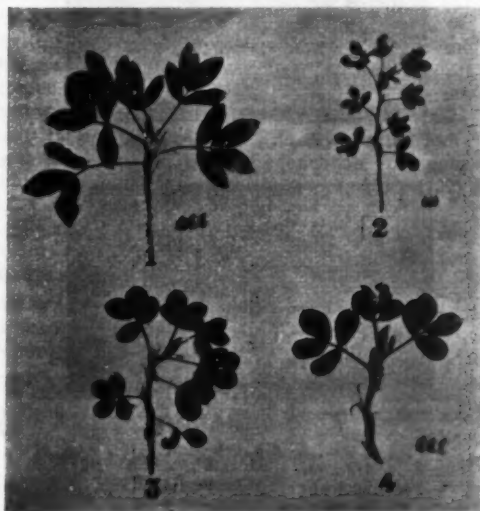
Botany Dept.,
Ravenshaw College,
Cuttack, India,
November 15, 1956.

B. SAMANTARAI.
T. KABI.

1. Samantarai, B. and Kabi, T., *Nature*, 1953, 172, 37.
2. —, *Phytomorphology*, 1954, 4, 446.
3. Arber, A., *The Natural Philosophy of Plant Form*, Cambridge University Press, 1950, p. 70.

A SYNTHETIC ALLOHEXAPLOID IN ARACHIS

INTERSPECIFIC hybrid of the cross *Arachis hypogaea* ($2n=40$) a tetraploid and *A. villosa* var. *Correntina* ($2n=20$) a diploid was first



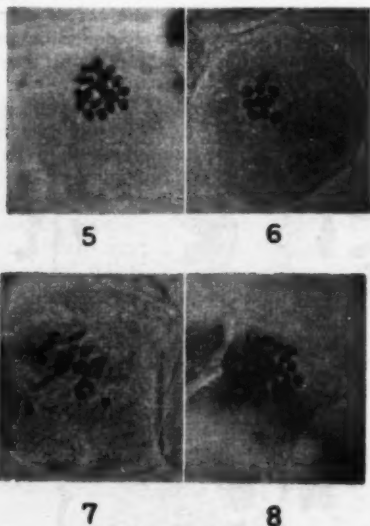
FIGS. 1-4

Fig. 1. *A. hypogaea* branch and seeds. Fig. 2. *A. villosa* var. *Correntina* branch and seeds. Fig. 3. Triploid hybrid of cross between *A. hypogaea* × *A. villosa* var. *Correntina* branch only. Fig. 4. *Hypogaea-Villosa* amphiploid branch and seeds.

reported by Krapovickas and Rigoni.¹ The hybrid produced by them had 30 chromosomes

in the somatic tissues indicating its triploid character. At meiosis they reported the occurrence of $10_{III} + 10_{ca}$. This hybrid was completely sterile. The sterility of the hybrid was observed to be due to irregularity in meiotic pairing in which ten univalents and ten bivalents were formed.

The same species cross of *Arachis* as that made by Krapovickas and Rigoni has been successfully repeated by the authors (Figs. 1, 2, 3, 5, 6 and 7). The hybrid flowered very profusely but did not set any seed. Most of the observations made by us confirm the findings of the previous investigators. With a view of obtaining a fertile plant, an allohexaploid was produced by doubling the chromosome number of the sterile hybrid. This was effected by treating the young vegetative buds of the hybrid with 0.2% colchicine solution in water after covering them with cotton wool, similar to the drop method of treatment described by Blacklee and Avery.² The allohexaploid thus produced became fertile and has produced seeds (Fig. 4). Chromosomal exami-



FIGS. 5-8

Fig. 5. *A. hypogaea*, Metaphase I, $\times 950$. Fig. 6. *A. villosa* var. *Correntina*, Metaphase I, $\times 950$. Fig. 7. Triploid hybrid, Metaphase I, $\times 950$. Fig. 8. *Hypogaea-Villosa* amphiploid, Metaphase I, $\times 950$.

nation showed that thirty bivalents were formed at the meiotic metaphase (Fig. 8). The details of the two parents of the interspecific hybrid and of the new allohexaploid are given in Table I.

The smears for examination of the chromosomes were prepared according to the method

TABLE I
Showing the characteristics of the parents, hybrid and amphiploid of the interspecific cross between *A. hypogaea* and *A. villosa* var. *Correntina*

	Habit		Chromosomes	Meiotic behaviour	Seed setting
	Growth	Duration			
<i>A. hypogaea</i>	Erect	3-4 months	40	20 _{II}	Normal
<i>A. villosa</i> var. <i>Correntina</i>	Spreading	Perennial	20	10 _{II}	Low
Hybrid	"	"	30	20 _{II} + 10 _I	Nil
Allohexaploid (<i>Hypogaea-Villosa</i>)	Semi-erect	"	60	30 _{II}	Normal

described by McClintock.³ The authors gratefully acknowledge help rendered by Shri A. S. Jadhav in taking the microphotographs. Botany Section, L. S. S. KUMAR, College of Agriculture, R. D'Cruz, Poona-5, February 12, 1957. J. G. OKE.

1. Krapovickas, A. and Rigoni, V. A. *Revista Invet. Agri.*, 1951, 5, 289.
2. Blacklee, G. F. and Avery, A. S., *J. Hered.*, 1937, 28, 393.
3. McClintock, B., *Stain Tech.*, 1929, 4, 53.

OCCURRENCE OF *TETIGELLA SPECTRA* (DISTANT): CICADELLIDAE HOMOPTERA ON SUGARCANE IN MYSORE

Box¹ recorded *Tetigella spectra* (Distant) Cicadellidae under the name *Cicadella spectra* Dist. among the pests of sugarcane in India. This species has not been listed by Gupta² in his review. No information is also at present available regarding the places of occurrence of this jassid on cane.

For the first time *Tetigella spectra* (Dist.) has been noticed in several cane-growing areas of Mysore. This jassid was found as a casual insect on sugarcane during 1952-54. During 1955, however, it occurred in increased numbers throughout the Visvesvaraya Canal Tract, a major cane-growing area of the State. A short account of the salient features of its biology and habits is given below.

Adults and nymphs suck the sap of the plant and copiously excrete a clear liquid in fine droplets on the blades and stems. The female makes a longitudinal slit on the inner side of the mid-rib by its dagger-like ovipositor for inserting the egg-mass in which elliptical, orange-coloured eggs are deposited one adjacent to the other. This slit appears as a streak,

parents,
ic cross
var.Seed
or settingNormal
LowNil
Normalgrate-
i A. S.
S.
UMAR.

a lwes.

1937.

DAE
IN(istant)
spectra
India.
pta² in
present
ence of(Dist.)
g areas
casual
During
num-
Tract,
te. A
ts bio-e plant
n fine
female
side of
or for
ceptical,
adja-
streak,

and the eggs may be seen through the thin membrane on the dorsal surface. The eggs are also laid in the lamina of the leaf and the succulent leaf-sheath. The number of eggs in an egg-mass ranges from 6 to 22, all hatching after an incubation period ranging from 11-13 days. The newly hatched nymphs wriggle out through the streak and immediately begin to feed on the plant sap which results in yellowish patches on the lower surface of the mid-rib. Under room temperature ranging from 73°F. to 81°F. (average 78°F.) the nymphal stages lasted 41 days with five moults. The adults generally conceal themselves in the leaf-whorl perching on the central growing stem. They hop and disperse on to the neighbouring canes or grasses. No attendant ants are seen with the nymphs or the adults in spite of the copious honey dew. The female is slightly bigger than the male and preponderates over the male in numbers. The adults live for 25 to 30 days on a cane plant.

Gonatocerus sp. (Mymaridae) parasitises the eggs and red mites *Leptus* sp. (Erythraeid mites) attach themselves firmly to the nymphs and adults and exercise some control over the jassid in nature.

The insect has to be considered as a potential cane pest, as damage to cane will result by its feeding as also by its act of oviposition, causing slits on the mid-rib and leaf-tissue.

My grateful thanks are due to Dr. M. Puttambudriah, for the encouragement given and to the U.S.D.A., and Commonwealth Institute of Entomology for the identification of the jassid and the parasite and mite respectively.

K. S. SIVASHANKARA SASTRY.

Division of Entomology,
Dept. of Agriculture,
Bangalore, December 4, 1956.

1. Box, E. H., *List of Sugarcane Insects*, 1953, Commonwealth Institute of Entomology, London.
2. Gupta, B. D., *A Review of the Publications of Sugarcane Pests in India (1934-54)*, Ministry of Food and Agriculture, Government of India, New Delhi, 1955.

ISOLATION AND ESTIMATION OF FENCHONE IN ESSENTIAL OILS AS THIOUREA COMPLEX*

ANGLA¹ has observed that fenchone could form crystalline adduct with thiourea. Since similar urea adducts have been used for the separation of fatty acids, etc., an attempt was made to separate fenchone from fenchone-hydrocarbon mixtures by this method. A fenchone-hydrocarbon mixture, containing 26 and 27% fenchone by the hydroxylamine and dinitro-

phenyl hydrazine methods, was prepared from *Adenosma malabarica* oil used for the studies. 10 ml. of the fraction were treated with 100 ml. of saturated thiourea solution and kept for 12 hours with occasional shaking. The precipitate was filtered off and washed first with saturated thiourea solution and then with a little benzene to remove adhering oil. The filter cake was transferred to a cassia flask and dissolved in water. The volume of oil liberated was 2.4 ml. corresponding to 24% fenchone by volume. Adducts can be formed in alcoholic solutions also, but the best results were got with aqueous solutions.

The advantages of the method are that it is relatively rapid and that the recovery of fenchone as well as the other constituents is quantitative. Investigations using about 25 different essential oils and 20 isolates indicate that apart from the compounds mentioned by Angla, no essential oil component forms adducts with thiourea. In cases where interfering constituents (such as camphor and borneol which also form adducts) are known to be absent, the technique can be applied directly to the oil itself.

The thiourea adducts show fairly sharp dissociation temperatures (within about 3°C.) similar to the dissociation temperatures shown by the fatty acid-urea complexes. Due to the higher vapour pressures of the essential oil components, rapid heating to a few degrees below the dissociation temperature is necessary for the best results. The dissociation temperatures for the borneol, fenchone, camphor and cyclohexanone adducts were 104°, 107°, 112° and 117° C. respectively.

We are grateful to Prof. K. N. Menon, Professor of Organic Chemistry, University of Madras, for guidance.

Maharaja's College, T. MADHAVA MENON.
Ernakulam, T. C. K. MENON.
January 11, 1957.

* This work formed part of the M. Sc. thesis submitted by T.C.K.M. to the Travancore University, in October 1953.

1. Angla, B., *Compt. Rend. Paris*, 1947, 224, 402.

A NEW SPECIES OF PARMELIA FROM KODAIKANAL, SOUTH INDIA

On the eve of his departure from India, Prof. Ove Arbo Høeg, ex-Director, Birbal Sahni Institute of Palaeobotany, Lucknow, sent to the author a collection of Lichens, which he made from Kodaikanal in August 1953. This collection has been incorporated in the author's Lichen herbarium and serially numbered

therein. Against the 14 specimens of the genus *Parmelia* in this collection, the specimens identified so far have been found to belong to *Parmelia cirrhata* Fr. (Nos. 2519 and 2521), *P. cetrata* Ach. (No. 2518), *P. dissecta* Nyl. (No. 2528), *P. laevigata* Ach. (Nos. 2524, 2526 and 2527), *P. Arnoldii* DR. (No. 2520) and *P. tinctorum* Despr. (No. 2523). One of the specimens found to be closely resembling *Parmelia bitteriana* Zahlbr., yet distinct in many respects, has been designated as a new species under the name *Parmelia pseudobitteriana* Awasthi. Description of this new species is given below with the following abbreviations: K = aqueous solution of potassium hydroxide; Cl = aqueous solution of calcium hypochlorite; K(Cl) = K followed by Cl; I = aqueous solution of iodine; and Pd = alcoholic solution of paraphenylenediamine.

Parmelia (Hypogymnia) pseudobitteriana
AWASTHI SP. NOV.

Thallus foliaceus, suborbicularis, laciniatus, superne cinereus, laciniae subdichotome ramosae vel irregulariter multifidae, inflatae, saepe ramulis adventivis instructae, ramulis brevioribus et angustioribus interdum diffuse sorediatis. Pagina inferior atra, nitidula, pertusa, rhizinis nullis, medulla parce evoluta. Cortex superior K + flavus, dein aurantiaco-fuscus, medulla K —, K(Cl) —. Apothecia podicellata, disco concavo, pallide olivaceo vel pallide cinereo. Sporae 8-nae, late ellipsoideae, simplices.

Habitat.—On bark of tree.

Locality.—South India, Kodaikanal; altitude 7,000 ft.; Coll.: O. A. Höeg, Aug. 8, 1953: No. 2515 in Herb. Author; Fig. 1: (TYPE).



FIG. 1. *Parmelia pseudobitteriana* Awasthi sp. nov.—TYPE.

Thallus foliose, spreading, suborbicular, the largest piece (Type specimen) measuring 11×7 cm. in size, central part somewhat devoid of laciniae, laciniae upto 4 cm. long, irregularly multifid, somewhat convex, apex rounded; often small adventitive branchlets present on the sides of the older laciniae; laciniae in some parts of the thallus wholly diffused sorediate and in others smooth esorediate; the sorediate laciniae convex and shorter and much narrower (1-1.5 mm. broad) than the esorediate ones (2-3 mm. broad), the latter often oblongish in the apical part. Thallus above ashy white to gray; below without rhizinae, shining, minutely wrinkled reticulated and black (apical part brownish); the sorediate laciniae white margined on the under-side due to the protrusion of the upper side; perforations on the under-side present and about 0.5-1 mm. in size.

Thallus corticated on both the sides, upper cortex $12-16 \mu$ thick, cell lumina minute about $1-2 \mu$ in size; algal zone 25μ thick, algal cells green, $12-16 \mu$ in size; medulla hollow, upper medulla including algal zone $100-110 \mu$ thick and colourless of loosely interwoven 3μ thick hyphae with minutely granular surface, lower medulla brown with thicker (4μ) hyphae. Upper cortex K + yellow then orange brown; medulla K —, K(Cl) —, Pd —.

Apothecia podicellate, 3-4 mm. tall and 2-2.5 mm. in diameter, cup-shaped; hollow in the region of the stalk, margin incurved; disc concave light olive to pale gray. Epithecium colourless to lightly yellowish, thecium (hymenium) colourless $25-30 \mu$ thick, I + blue hypothecium colourless; asci club-shaped 8-spored; spores single-celled, colourless, oval ellipsoid, slightly thick-walled, $8-9 \times 5-6 \mu$ in size; paraphyses thick, septate and branched.

Distinguished from *Parmelia bitteriana* Zahlbr. by the habit of the thallus, cortex K + yellow ultimately orange brown, Medulla K(Cl) —.

The author expresses his grateful thanks to Prof. O. A. Höeg (Norway), for placing at his disposal this collection of Lichens, to Dr. A. H. Magnusson (Sweden) for verification and translating specific diagnosis into Latin, and to Prof. S. N. Das-Gupta for guidance and encouragement in the prosecution of this work.

Dept. of Botany,
Lucknow University,
Lucknow, December 12, 1956.

D. D. AWASTHI.

CHROMOSOME NUMBER AND SEX MECHANISM IN TWENTY SPECIES OF THE INDIAN HETEROPTERA

THE chromosome number and sex mechanism in twenty species of the male Indian Heteroptera, belonging to the families Pentatomidae, Lygaeidae, and Coreidae, were investigated in this laboratory and are presented in Table I.

The data on these species are being reported for the first time and constitute an addition to

TABLE I

Species	Chromosome number (2n)	Sex mechanism
Family— PENTATOMIDAE		
Sub-family— CYDNINAE		
1. <i>Macrostyctus subaneus</i>	12	XY
2. <i>Stibaropus malginus</i>	31	XXV
Sub-family— PENTATOMINAE		
Division— Dorpiaria		
3. <i>Neodius</i> sp.	16	XY
Division— Eusarcocoriaria		
4. <i>Eusarcocoris inconspicuus</i>	14	XY
Division— Tropicoraria		
5. <i>Placosternum urnus</i>	14	XY
Division— Eurydemaria		
6. <i>Eurydema lituriferum</i>	14	XY
Division— Carpocoraria		
7. <i>Halyomorpha brevis</i>	14	XY
Family— LYGAEIDAE		
Sub-family— LYGAEINAE		
Division— Lygaearia		
8. <i>Lygus longulus</i>	14	XY
Sub-family— APHANINAE		
Division— Aphanaria		
9. <i>Aphanus sordidus</i>	12	XY
10. <i>Dieuches</i> sp.	12	XY
11. <i>Laenophorus singalensis</i>	12	XY
Family— COREIDAE		
Sub-family— CORIEINAE		
Division— Homocercaria		
12. <i>Homocercus simidus</i>	21	XO
13. <i>Homocercus signatus</i>	21	XO
14. <i>Homocercus indus</i>	21	XO
15. <i>Homocercus</i> sp.	21	XO
Division— Petascelaria		
16. <i>Petillia calcar</i>	28	XXO
Division— Gonocercaria		
17. <i>Cleus trigonus</i>	18	XXO
Division— Attractaria		
18. <i>Akbaratus fasciatus</i>	14	XXO
19. <i>Akbaratus fisheri</i>	13	XO
Sub-family— COREIZINAE		
Division— Corizaria		
20. <i>Liorhyssus hyalinus</i>	13	XO

our previous knowledge of about sixty Indian species.¹⁻⁹

The details of the structure and behaviour of the chromosomes along with their metrical analysis will be shortly published elsewhere.

Zoological Laboratory,
Panjab University,
Hoshiarpur, November 18, 1956.

RAM PARSHAD.

1. Dass Gupta, J., *Curr. Sci.*, 1950, 19, 323.
2. Manna, G. K., *Proc. Zool. Soc.*, Bengal, 1951, 4, 1.
3. Ray Chaudhuri, S. P. and Manna, G. K., *J. Genetics*, 1952, 51, 101.
4. —, *Proc. Zool. Soc.*, Bengal, 1955, 8, 65.
5. Sharma, G. P. and Parshad, R., *Res. Bull. Panj. Uni.*, 1955, 72, 67.
6. —, *Cytologia*, 1957 (In press).
7. Parshad, R., *Caryologia*, 1956, 8, 349.
8. —, *Proc. Ind. Sci. Congr.*, 1957, 3, 334.
9. Dutt, M. K., *Ibid.*, 1957, 3, 332.

A KEY TO THE IDENTIFICATION OF IMPREGNATED EGGS OF COMMON FRESH-WATER FISHES OF BENGAL

IN Bengal there is an age-long practice of pond culture. For stocking of ponds, the impregnated eggs and newly-hatched larvae of certain carps are obtained from either bundh type of tanks or the river where most of the fishes in this area breed. The trade in such fish seed has assumed enormous importance in recent years as there is a great demand for fish seed, particularly of the major carps all over India. Where only fish eggs are collected for cultural operations great difficulty is experienced both by fishermen and fishery workers in regard to their identification. The identification of eggs that are being collected for hatching and rearing is very essential as one has to discriminate between the eggs of desired and undesired species of fishes.

With a view to provide a simple key for the identification of the eggs of common species of fishes occurring in Bengal, an extensive study on the characters of the eggs of various species of fishes was undertaken under the guidance of late Prof. H. K. Mookerjee from 1937 to 1942 under the scheme sponsored by the then Indian Council of Agricultural Research. Prof. Mookerjee¹ published a table for identification of eggs of common fresh-water fishes. But this needs certain modifications. Since then further observations have been made on this subject and these are presented in Table I. In the case of *Catla catla* it has been observed that although the eggs are demersal to begin with they gradually become buoyant and eventually come to float at the surface of the water. The size of the eggs of all species mentioned in Table I is from the stage of attainment of their maximum swelling which occurs before the first cleavage of animal pole. This size is retained till hatching of the embryo.

TABLE I
Giving features for identification of eggs of common fresh-water fishes of Bengal

I. NON-FLOATING: (A) <i>Non-adhesive</i> —		
(i) Size 6 mm., round, vitelline membrane transparent	..	<i>Catla catla</i>
(ii) Size 5.5 mm., round, vitelline membrane transparent, light red	..	<i>Cirrhina mrigola</i>
(iii) Size 5 mm., round, vitelline membrane transparent, reddish	..	<i>Labeo rohita</i>
(iv) Size 4.5 mm., round, vitelline membrane transparent, bluish	..	<i>Labeo calbasu</i>
(v) Size 4.2 mm., round, vitelline membrane transparent, bluish	..	<i>Labeo gonius</i>
(B) <i>Adhesive</i> : (a) <i>Non-filamentous</i> —		
(i) Size 1.5 x 1.3 mm., oval, greenish	..	<i>Clarias batrachus</i>
(ii) Size 2.5 mm., round, yellowish	..	<i>Wallagonia attu</i>
(iii) Size 3.5 mm., round, yellowish	..	<i>Notopterus notopterus</i>
(iv) Size 6.5 mm., round, yellowish	..	<i>Notopterus chitala</i>
(v) Size 2 mm., light brown	..	<i>Mastecembelus pancalus</i>
(b) <i>Filamentous</i> —		
(i) Size 1 mm., round, short and long filaments	..	<i>Oryzias melastigma</i>
(ii) Size 1.4 mm., round, no short filament	..	<i>Aplocheilichthys panchax</i>
II. FLOATING: <i>Non-adhesive</i> —		
(i) Size 1 mm., round, greenish, small	..	<i>Ophicephalus punctatus</i>
(ii) Size 1.3 mm., round, amber-coloured, medium	..	<i>O. striatus</i>
(iii) Size 1.5 mm., oval, amber-coloured	..	<i>O. marulius</i>
(iv) Size .9 mm., round, transparent	..	<i>Anabas testudineus</i>
(v) Size .75 mm., round, transparent	..	<i>Colisa fasciatus</i>
(vi) Size .7 mm., round, transparent	..	<i>Colisa latius</i>

Directorate of Fisheries, S. R. MAZUMDAR.
West Bengal, Calcutta,
February 22, 1957.

I. Mookerjee, H. K., *Science and Culture*, 1945-46,
11, 18.

NEW APPARATUS AT THE PHYSICAL SOCIETY EXHIBITION

MANY new instruments for special uses were shown at the recent Annual Exhibition of the Physical Society held in London.

Perhaps the most futuristic was a transportable version of the caesium atomic clock, which has been developed under a study contract for the Royal Aircraft Establishment, Farnborough. It keeps time to an accuracy of one part in a thousand million.

Its immediate use will be, no doubt, for the precise control of radio frequencies, but it could be used also to control a clock. It is impressive that a device, which only two years ago was at the stage of pioneer measurements in a laboratory, should have reached the stage when it could be transported to any country in a form immediately capable of use.

The Capenhurst Laboratories of the U.K. Atomic Energy Authority contributed a mass spectrometer designed for the special job of measuring the proportions of the two isotopes of lithium present in a solid sample. Lithium 6 has been commonly reported to be an ingredient of thermonuclear weapons, and has been mentioned officially in connection with the possible eventual use of such reactions in power stations. The mass spectrometer, which has been developed, can also be used for measurements on solid specimens of other elements.

In a similar context, the Armament Research and Development Establishment, Fort Hal-

stead, showed a high-speed camera for the study of the early stages of explosions; it takes a sequence of 12 pictures, with exposure times which may be as short as one ten-millionth of a second and the interval between pictures is adjustable between less than a millionth and a thousandth of a second.

The Mining Research Establishment of the National Coal Board at Isleworth had a portable instrument designed to measure small changes in air pressure under practical mining conditions. Its use is for the control and testing of ventilation. Another form of air measurement—that of vertical gustiness in the lower atmosphere—was demonstrated, with the aid of an electric fan, by the Experimental Defence Establishment, Porton. It has been designed for operation from a captive-balloon cable, and gives information about the extent of mixing that takes place in the atmosphere under different conditions.

A trouble-saving instrument for nuclear physicists was shown by the Cavendish Laboratory, Cambridge. So many photographs showing tracks of nuclear particles are now available for analysis that the translation of photographs into measurements has become laborious. From simple lining up operations, performed on a pair of photographs, the instrument feeds an electronic computer with all the information that it needs to calculate the lengths, angles, and curvatures of each track.

REVIEWS

Flood Estimation and Control. Third Revised Edition. (Chapman & Hall), 1955. Pp. xiii + 187. Price 35 sh.

As the cover flap of the book very prominently displays, the flood problem most certainly remains of the greatest importance to civil engineers who have to design reservoirs, flood-water channels, roads and other projects. The book, it is added, has been specifically designed to aid them in their work.

The book opens out with an introductory chapter describing the complicated nature of the flood estimation problem. It also lists the various possible methods of obtaining dependable solutions. Statistical methods are mentioned as offering the most reliable solutions; but on account of scantiness of data relating to floods, fuller consideration of the methodology is not followed up as lying outside the scope of the book. Instead, the author proceeds to devise a broad mathematical approach which yet retains its practicality in form by severely limiting the number of coefficients to express only the variations of the major factors. Starting from the universal canal flow formula :

$$V = c \sqrt{rs}$$

the central theme of the approach consists in developing an expression for the period of concentration of the flood arising from a storm over the catchment. Five of the six major factors listed earlier find expression in the principal formula evolved. So far, the approach seems straightforward. It is only when the author proceeds to demonstrate the application of the formula that the relative importance of the various factors size up differently and the field gets widened. Thereupon the author makes several reservations, but these help only to further restrict the scope and usage of the formula(s).

The author's earlier formula $f(a)$ for the ratio of the average to maximum rainfall intensity in terms of the area covered by a storm may be mentioned as an instance in point. Correctly speaking, the relation cannot be said to have been established with any consistency. The whole ground seems very slippery when the author feels constrained to remark, "the wide variation between the results of individual storms gives rise to some doubt as to whether any definite relation can be established

between rainfall intensity and area; on the other hand, the close similarity between the range of percentage intensity and also between the average percentage of the northern and southern groups appears significant and suggests a relationship".

The readers too are possibly not convinced. To generalise from such slippery premises or to evolve a theory therefrom does not augur well until positive proof is produced otherwise of its soundness. While "the general results" may "not be materially affected" by any slight modification of the author's curves, etc., it will be equally necessary to remember that there may be other approaches which provide similar or better estimates in individual cases.

Again in describing in Chapter VI the detailed procedure for evaluating the six coefficients descriptive of the major factors' variations, particularly the C and K coefficients of any individual catchment, it is rather disappointing to find the author concluding "catchments vary so greatly that it is impossible to do more than generalise on the subject . . .". The import of the remark is not very far from stating the tough problem back in its original form.

Chapters VII to IX again follow the straightforward pattern of constructing the flood hydrograph with the help of the formulæ developed early in the book. The effects thereon of variations of the several coefficients are also described but they rather lend a touch of hypotheticalness to the treatment despite its systematic thoroughness otherwise.

Comparisons are made in Chapter X of the flood data recorded in four instances for the basins named with corresponding estimates deduced from the theory developed. The conclusions drawn are tentative and are not sufficiently convincing. As the author himself has aptly summarised, "much further data and research are evidently required" to get better satisfactory coefficients or formulæ. Till then not much progress can be claimed to have been achieved in solving the intricate flood estimation problem.

Much useful discussion is contained in the last three chapters of the book, namely, on Flood Control; Floods in Relation to Soil Erosion; and Examples in Flood Calculation. The table presented in Appendix I for the values

of $t^2/t+1$ for aiding the computation of the time (t) of concentration by inverse interpolation will prove immensely useful for the field staff engaged in estimating and regulating flood run-offs.

D. V. JOGLEKAR.
G. M. PANCHANG.

Analysis of Bistable Multivibrator Operation. (The Eccles-Jordan Flip-Flop Circuit.) By P. A. Neeteson. (Philips Technical Library, Series on Electronic Valves, Book X), 1956. Pp. 82. Available from Philips (India) Private, Ltd., Calcutta. Price Rs. 8-12-0.

The monograph under review has been originally written as a Doctoral Thesis at the Technical University of Delft and is now published as a volume in the Series of Electronic Valves of the Philips Technical Library. It deals with the 'flip-flop' circuit first developed by Eccles and Jordan as far back as 1919 but which has found widespread application in the last decade in a variety of electronic circuits, such as computers, scalars, etc.

In the analysis of such a circuit, it has been conventional to consider the static condition when the circuit is at rest. But from the point of view of triggering speed and sensitivity, which are essential parameters in any practical circuit and of far greater interest, is what happens to the multi-vibrator during the time it is switching over from one stable state to the other. Such a dynamic analysis has to take into account three distinct phases: At any instant $t < 0$, Tube I is conducting and drawing grid current. When the trigger pulse is applied at $t = 0$, both the tubes become non-conducting in a short time depending on the tube characteristics and circuit components. The second phase starts when Tube II begins conducting with increasing anode current and the third phase commences when grid current starts to flow in Tube II causing new transients to be superimposed on those resulting from the preceding two phases.

The analysis of such a circuit is performed with the following assumptions regarding the shape of the trigger voltage, its amplitude and slope of the negative-going wave front. The voltage between grid and cathode of the conducting tube is taken as zero which is very nearly so when it is drawing grid current. The internal resistance of the supply voltage and trigger voltage source is neglected which is valid in most practical cases. The anode and grid capacitances of each tube are neglected to simplify the analysis, but all other tube, wiring

and stray capacitances are considered. With these valid assumptions, the static and dynamic analysis of the circuit is carried out, which enables the influence of the tube characteristics, circuits components and pulse shape on the trigger sensitivity to be computed. Further, an approximate idea of the maximum triggering speed is obtained from the analysis. Finally, some considerations in designing such circuits with high trigger speed, high sensitivity, high stability and low power consumption are outlined. In fact, the investigation, says the author, was prompted by a practical problem and has resulted in the development of special tubes for pulse work.

Considering the need for a thorough knowledge of the multi-vibrator circuits on the part of all electronic engineers, the book will be read with profit and interest by all communication engineers and computer designers. The get-up and format conform to the high standard of the other volumes in the series.

RAM K. VEPA.

Automation in Theory and Practice. (A Course of Lectures organised by E. M. Hugh-Jones.) (Oxford, Basil Blackwell), 1956. Pp. 134. Price 12 sh. 6 d. net.

The contents, which is a collection of seven lectures delivered by experienced personalities, will be of interest largely to trade unionists, business consultants, sociologists and economists. The first three lectures have a scientific and industrial touch about them and convey popular expositions of terms like feed-back, automatic pilot, time-lag, damping, control systems, etc., with suitable illustrative examples. The remaining chapters are wholly devoted to the reaction that the development of automation may have on trade unions, and on administrative, social, and economic structures. These chapters offer useful and interesting reading, especially to the economist. It is doubtful if the contents of the book will justify the title that it bears. A student of science and technology would wish that a title more appropriate to the contents could have been chosen.

S. HARIHARAN.

Eels—A Biological Study. By Leon Bertin. (Cleaver-Hume Press, London), 1956. Pp. vi + 192. Price 25 sh.

There are very few books written exclusively on one particular fish and few fishes deserve this distinction as the eels do. Their entering

APRIL
rivers
stout,
swim
duce
posse
life in
capaci
away
lectua
men o
answe
ever,
finding
st
gratitu
sentati
to tho
Of c
fore w
logy o
especi
fore w
animal
theless
of valu
ends.
has no
other
read
person
Now th
educat
ground
human
such a
of all
Aureon
Lepp
and
Mon
Inc.,
This
graphs
Welch
by eigh
broad-s
it has
its acti
It is n
its you
cycline.
117 pag
antibiot
heading
Property

rivers early in life and growing into long, stout, snake-like creatures which years later swim down the rivers into the sea to reproduce, their value as food and the capacity they possess in adjusting their physiology to suit life in both fresh-water and marine, and their capacity to make long journeys in land and away into the sea, have challenged the intellectual curiosity and excited the wonder of men of all lands. We are far from possessing answers to all the questions they raise. However, Leon Bertin's effort to bring together the findings of different authors relating to different species of eels in the world deserve our gratitude. His simple language and clear presentation will render his book readable even to those not familiar with technical terms.

Of course it will be several generations before we have a complete picture of the physiology of all the aspects of the life of fishes, especially the eels. Centuries may go by before we understand the migratory instinct of animals like fishes, birds and mammals. Nevertheless periodical reviews of our progress are of value at least in showing the loose dangling ends. Notwithstanding the fact that the author has not referred to *Anguilla bengalensis* and other eels of Indian waters, the book must be read by every student of zoology and every person who has an interest in natural history. Now that universities in India are realising the educative values of giving a scientific background to students who opt for studies in humanities, books dealing with general biology such as Leon Bertin's must be on the shelves of all the colleges.

C. P. GNANAMUTHU.

Aureomycin (Chlortetracycline). By Mark H. Lepper. Foreword by Henry Welch and Felix Marti-Ibanex, Antibiotics Monographs No. 7. (Medical Encyclopaedia, Inc., New York.) Pp. 156. Price \$4.00.

This is the seventh of the series of the monographs brought out under the editorship of Welch and Marti-Ibanex and to be followed by eight more. Aureomycin is the first of the broad-spectrum antibiotics to be discovered and it has excited particular interest because of its action on the Rickettsia and some viruses. It is naturally more extensively studied than its younger brothers, terramycin and tetracycline. This monograph gives, in a space of 117 pages, what one has to know about this antibiotic in relation to clinical use, under the headings: History and Physical and Chemical Properties; Antimicrobial Activity; Pharma-

cology; Experimental Infections; Principles of Chlortetracycline Therapy; Infections Caused by Gram-Positive and Gram-Negative Cocci; Gram-Positive Bacterial Infections by Gram-Negative Bacterial Infections; Spirochetal Infections; Rickettsial Infections; Infections Caused by Viruses of the Lymphogranuloma-Psittacosis Group; Protozoal Infections; Fungal Infections; Infections of Unidentified Etiology; and Chlortetracycline in Prophylaxis. What is given is not a mere compendium but a very concise and critical appraisal of the data available by an authority. There is a bibliography of 32 pages listing 769 references and a very valuable index running to six pages. The reviewer considers this to be the best monograph he has gone through; and in this one sees both the wood and the trees. This monograph is bound to be of great value to the clinician and the researcher.

Scanning the references rapidly, one finds that about 90% of them are from America. From the rest there are 32 references from Britain, a dozen from Scandinavian countries, 6 from Germany and a few each from other countries including two from India. Antibiotic research and development still appear to be the privilege of the Americans.

K. GANAPATHI.

Crop Pests and How to Fight Them. (Published by the Directorate of Publicity, Government of Bombay, Bombay), August 1956. Pp. v + 204. Price Rs. 2.

The present handsome brochure, which is the outcome of a collaboration between the Directorates of Publicity and Agriculture of the Bombay State, affords clear proof of the recognition given to the importance of pest control in our national economy. During the years that followed the Second World War, there has been a growing awareness of the role of scientific plant protection in the context of fighting chronic food shortage. Plant protection services have been established at the Centre and in the various States for helping the cultivators to fight pests and diseases of crops and for undertaking concerted measures against pests like the locusts and the army worms, which often transcend State boundaries or affect wide areas.

The advent of modern synthetic insecticides, like DDT, BHC and Parathion, has perforce opened a new chapter in plant protection techniques. Common pesticides formerly in vogue, like the arsenates, tobacco decoction and

copper sulphate, although they carried health hazards, were types whose properties were well understood. The new products now available in the market are insecticides which are more insidious in their action, and have to be handled with particular care, if untoward consequences to the operator and the consumer are to be avoided. In view of the spectacular effect of some of these insecticides, they have become attractive to the cultivators and it is essential to provide technical guidance to the users to prevent mishaps.

The appearance of this handbook is, therefore, quite opportune and is to be welcomed. Written in simple and popular style, by the various members of the Bombay Entomological Section, the brochure covers almost the entire ground of the information needed by Departmental Field Officers and literate farmers in tackling their crop protection problems.

The first five chapters are devoted to general information about insect pests and about various insecticides recommended for use against insects. Chapters VI to XVI are devoted to the important pests of various crops, with notes on their distribution, habits and methods of control. Chapter XVII concerns locust control, Chapter XVIII treats of termites, Chapter XIX is about field-rats and other noxious wild animals and Chapter XX gives information on Sprayers and Dusters. The Appendices give practical hints on the steps to be taken in dealing with infestations and on the dosage of the various insecticides when applied on a field scale. A glossary of the common names of the different crop pests in the three languages prevalent in the Bombay State is appended. The booklet is well illustrated and includes four composite colour plates of pests.

In a popular publication of this kind, it is perhaps inevitable that some useful items of information such as a conversion table of weights and measures have not found a place. Parathion compounds, which have of late come largely into the picture, find no mention. It would have been a better plan to mention the scientific names of the pests in the body of the text, as that would have given an element of definiteness in respect of their identity, instead of obliging the reader to refer to the glossary for the information. An index at the end might have been a useful addition.

In Chapter I, the figures given in respect of the number of individuals to be found in locust swarms would seem to be underestimates, erring too much on the safe side; and there appear to be also a good number of printing

and other errors in the body of the text. But these do not in any way detract from the real usefulness of the handbook under review.

D. S. RAO.

Antibiotics in Nutrition. (Antibiotics Monograph No. 4.) By Thomas H. Jukes. (Published by Medical Encyclopaedia, Inc., New York), 1955. Pp. 128. Price \$4.00.

The volume under review summarises critically the work done for nearly a decade on the nutritional aspect of antibiotics relating to humans, animals, birds and insects, and the particular effect antibiotics exert on bacterial metabolism. Just how important the developments are economically may be gauged from the author's comment: 'Never before has a medicinal drug been used in animal feeding or in the diet of humans to stimulate nutrition and promote speed and extent of growth.' The volume covers 400 references and the facts thus accumulated has been discussed in a masterly way.

The book is divided into five chapters; the introduction discusses the established chemical structures of a variety of antibiotics, particularly penicillin, streptomycin, chlorotetracycline (aureomycin) and oxytetracycline (terramycin) and bacitracin. Reference has been made to the significant effects of these antibiotics on bacterial metabolism. The increase in the growth rate of animals has been attributed to the suppression of the harmful bacteria that animals harbour in their gastro-intestinal tract.

The second and third chapters are devoted to the discussion of the mechanism of growth due to the antibiotics and the influence of the antibiotics on the alteration in the requirements of nutrients. It has been pointed out that the inclusion of an antibiotic in the diet has little effect on certain vitamins, minerals and proteins so that considerable saving in the quantity of the diet could be secured. A higher growth rate may also be achieved in farm animals, with a view to enhance meat production.

In the last two chapters, the author discusses the role of antibiotics in animal nutrition and production as also a few of the physiological effects.

The role of antibiotics in improving the carcass quality as well as the meat value has also been indicated. Elaborate discussions on the applicability of antibiotics in the rearing of domestic animals, such as swine, cattle, sheep

and goats and poultry for speedy meat and egg production is particularly interesting to the veterinarian.

The lucid presentation of the enormous amount of available data in a book of this size is really creditable, and the book will be a useful addition to the library of medical and veterinary institutions alike. The get-up of the book is in consonance with the other publications of the series.

R. L. KAUSHAL.
B. BHEEMESHWAR.

Books Received

The Adrenal Cortex. By I. Chester Jones. (Cambridge University Press), 1957. Pp. x + 315. Price 37 sh. 6 d.

The Cathode Ray Oscilloscope—Circuitry and Practical Applications. By J. Czech. (Philips Technical Library. Available from Philips Electrical Co., Ltd., 7, Justice Chandra Madhab Road, Calcutta-20), 1957. Pp. xii + 340. Price Rs. 29-4-0.

Structure Reports for 1940-41. Edited by A. J. C. Wilson. (International Union of Crystallography, N. V. A. Oosthoek's Uitgevers, MIJ, Utrecht.) Pp. viii + 384.

Hydromedusae from the Discovery Collections. By P. L. Kramp. (Cambridge University Press.) *Discovery Reports*, Vol. 29 (1957). Pp. 128. Price 63 sh.

The Water Relations of Terrestrial Arthropods. (Cambridge Monographs in Experimental Biology, 5). By E. B. Edney. (Cambridge University Press), 1957. Pp. vi + 108. Price 15 sh.

The Physiology of Reproduction in Fungi. (Cambridge University Press.) Pp. 128. Price 15 sh.

Interscience Tracts on Physics and Astronomy No. 4—*Magnetohydrodynamics.* By T. G. Cowling. (Interscience Pub.), 1957. Pp. viii + 115. Price \$ 3.50.

Encyclopædia of Chemical Technology, Vol. XV. Edited by Raymond E. Kirk and Donald F. Othmer. (Interscience Pub.), 1956. Pp. xiv + 936. Price \$ 30.00.

Methods in Enzymology, Vol. III. Edited by S. P. Colowick and N. O. Kaplan. (Academic Press Inc.), 1957. Pp. xxiv + 1154. Price \$ 26.00.

Semimicro Qualitative Organic Analysis. By N. D. Cheronis and John B. Entrikin. (Interscience Pub.), 1957. Pp. xiv + 774. Price \$ 9.00.

SCIENCE NOTES AND NEWS

Leaf-Spot of Turmeric (*Curcuma longa*)

Sri. D. N. Borthakur, Department of Botany, Assam Agricultural College, Jorhat, writes: A severe leaf-spotting of the turmeric plants have been observed in several places of Assam during the past few years. On isolation and examination, the organism was found to be *Colletotrichum curcumæ* (Syd.) Butler and Bisby. This is the first record of the disease from Assam.

The disease has been recorded in India previously, and it has also been studied, particularly in the Madras State. The organism was originally referred to the genus *Vermicularia*, but was later transferred to *Colletotrichum* by Butler and Bisby ("The Fungi of India"—Sci. Monograph of the Imperial Council of Sci. Research, 1928).

"Atoms for Peace" Award, 1956

Prof. Niels Bohr has been awarded the "Atoms for Peace" Award for 1956, carrying with it an honorarium of \$ 75,000 made by the

organization of that name which was set up in 1955 as a memorial to Henry and Edsel Ford. Prof. Bohr, who is one of the foremost nuclear physicists of the present day, is the first recipient of this signal honour.

International Conference on Radio-Isotopes

An International Scientific Conference on the Use of Radio-Isotopes in Research will be held under the auspices of the UNESCO in Paris during September 1957. The Conference will work in two main sections. The first will deal with the role of radio-isotopes in the field of physical sciences such as geology, geophysics (including meteorology and oceanography) and metallurgical and industrial research, while the second will take up the use of radio-isotopes in biochemistry (including plant biochemistry and photosynthesis), human and animal physiological research, nutrition research, basic medical research and certain branches of agricultural research including soil fertility, plant and animal pathology and the use of insecticides.

Journal of Molecular Spectroscopy

Academic Press, Inc., announce the publication of a new journal with the above title devoted to publication of original research papers dealing with molecular spectra in emission and absorption, molecular spectra in the ultraviolet, the visible, the near and far infrared, and in the microwave region. It will also contain contributions on Raman spectroscopy and radio frequency spectroscopy (including nuclear magnetic resonance spectroscopy).

The new periodical will accept for publication papers dealing with such closely associated aspects of this subject as intensity measurements and line width measurements as well as interpretation of spectra, molecular dynamics, and the electronic energies of molecules. Manuscripts dealing with both the experimental and the theoretical aspects of molecular spectroscopy will be welcomed.

The journal will prove of value to physicists and chemists interested in the structures of molecules, the strengths of bonds, molecular parameters, intensities, and dipole strengths. It is planned to publish Volume 1, consisting of 4 issues, during 1957. Volume 1, Number 1, is scheduled for release in May 1957. Subscriptions for Volume 1, priced at \$10.00, should be sent to the publishers, Academic Press, Inc., 111, Fifth Avenue, New York-3. The journal will be edited by Dr. Harald H. Nielsen, Department of Physics, Ohio State University, Columbus, Ohio.

Endeavour Prizes

The Imperial Chemical Industries (Publishers of the quarterly scientific review, *Endeavour*) have offered the sum of 100 guineas to be awarded as prizes for essays submitted on a scientific subject. The competition is restricted to those whose twenty-fifth birthday falls on after 1st June 1957. The subjects for the essays are as follows: The International Geophysical Year; Science Fiction; Irish Contributions to Science; Atmospheric Pollution; Chemistry and the Conquest of Disease; Particles in Plant and Animal Cells.

The essays, which must be in English and typewritten, should not exceed 4,000 words in length, and only one entry is permitted from each competitor. Essays must be submitted without signature. The competitor's full name and address and date of birth should be disclosed in a sealed covering letter attached to the essay and addressed to: The Assistant Secretary, British Association for the Advance-

ment of Science, Burlington House, Piccadilly, London, W.1., and must be received before June 1, 1957.

Surveying by Radio Waves

A new system of precise measurement of distance, which is likely to have important applications in surveying, civil engineering and construction work of major nature, was demonstrated in London recently by Mr. T. L. Wadley, of the National Telecommunications Research Laboratory, S. African Council for Scientific and Industrial Research.

The 'tellurometer', as the device is called, depends on a radio technique, somewhat similar to radar except that continuous waves instead of pulses of energy are transmitted and distances up to 30 miles or so are measured in relation to the time taken by the radio waves to travel over the length to be determined, with an accuracy of 10^{-9} of a second. Thus at a range of 10 miles an error of 3 in. might be expected; a distance of 30 miles could be measured within 6 in.

It is claimed that the tellurometer could provide an answer in half-an-hour to a problem which, using classical surveying methods would normally take six qualified surveyors and 50 labourers from five to six weeks to complete. Mr. T. L. Wadley is to present a paper on the subject at a Meeting of the Royal Geographical Society on April 24.

National Metallurgical Laboratory, Jamshedpur

Dr. B. R. Nijhawan has been appointed Director of the National Metallurgical Laboratory, Jamshedpur. Dr. Nijhawan joined the National Metallurgical Laboratory early in 1949 as Assistant Director and was appointed Deputy Director early in 1953. He has published about a hundred technical and research publications on diverse metallurgical subjects and a book on "Austenitic Grain Size Control of Steel". Dr. Nijhawan's research interests cover a wide field, including also powder metallurgy, aluminium and the production of ferro-chrome and aluminium-silicon alloys under Indian conditions.

Award of Research Degree

The Andhra University has awarded the D.Sc. Degree in Physics to Sri. M. Sri Rama Rao for his thesis entitled, "Studies on Ionospheric Winds and Radio Fading".

The University of Poona has awarded the Ph.D. Degree in Physics (Phonetics) to Shri B. Chaitanya Deva for his thesis entitled "Psychophysics of Speech Melody in Dravidian".

SUNVIC ELECTRONIC RELAY

MODEL EA-3M



Sunvic Electronic Relay, Model EA-3M, is designed to allow light Contact Instruments, such as Toluene Regulators or Contact Thermometers, to achieve in service the precise control of which they are capable.

- Operates on a few microwatts.
- Controls upto 2 kw. at 230 volts AC/DC.
- Suitable for inductive loads.
- Self-contained with Mains Transformer, Gas-filled Relay and Sunvic Hotwire Vacuum Switch.

Made by
SUNVIC CONTROLS LIMITED, HARLOW, ENGLAND

Accredited Agents

MARTIN & HARRIS (PRIVATE) LTD.

(SCIENTIFIC DEPARTMENT)

SAVOY CHAMBERS, WALLACE STREET, BOMBAY 1

ANNOUNCING
RESEARCH & INDUSTRY

A NEW MONTHLY PERIODICAL ADDRESSED TO INDUSTRY

TECHNICAL DIGESTS * PATENTS & PROCESSES AVAILABLE
FOR LICENSING REVIEW OF PATENTED INVENTIONS
IN SELECTED FIELDS INVITED ARTICLES *
NOTES * ENQUIRIES

ANNUAL SUBSCRIPTION Rs. 8

For particulars, please write to :

THE ASSISTANT SECRETARY
PUBLICATIONS DIVISION
Council of Scientific & Industrial Research
OLD MILL ROAD, NEW DELHI-2

INDIAN COUNCIL OF AGRICULTURAL RESEARCH

INDIAN FARMING

Farmer's Own Magazine

Designed to serve the interests of the Indian farmers to a wide extent, **Indian Farming**, published in an attractive format, carries besides feature articles, topical notes, etc., special interviews with farmers and material for guidance of day-to-day farming operations. A popular monthly magazine for the public.

Annual Subscription : Rs. 9

Single Copy : As. 12

Available from :

THE BUSINESS MANAGER
I.C.A.R., QUEEN VICTORIA ROAD
NEW DELHI

INDIAN JOURNAL OF AGRICULTURAL SCIENCE

Annual Subscription: Rs. 15

(Quarterly)

Single Copy: Rs. 4

INDIAN JOURNAL OF VETERINARY SCIENCE AND ANIMAL HUSBANDRY

Annual Subscription: Rs. 12

(Quarterly)

Single Copy: Rs. 3

Available from :

THE MANAGER OF PUBLICATIONS
CIVIL LINES, DELHI 8

—RELIABLE HOUSE FOR—

- ❖ LABORATORY GLASSWARES
(Plain and Graduated)
- ❖ THERMOMETERS & HYDROMETERS
(Various ranges)
- ❖ LABORATORY PORCELAINWARES &
SILICAWARES
- ❖ NICKEL AND PLATINUMWARES
- ❖ WHATMAN FILTER PAPERS
- ❖ MICROSCOPES & ACCESSORIES
- ❖ BALANCES, TINTOMETERS, AEROGEN
GAS PLANTS AND OTHER INSTRU-
MENTS REQUIRED BY CHEMICAL
LABORATORIES

Contact:

UNIQUE TRADING CORPN.
51-53, Babu Genu Road
BOMBAY 2

Gram 'UNILAB' Phone: 30011

BOROSIL
LABORATORY GLASSWARE

such as

FLASKS, BEAKERS, CONDENSERS,
MEASURING FLASKS, MEASURING
CYLINDERS, PIPETTES & ANY
SPECIAL APPARATUS MADE TO
DESIGN

and

PENICILLIN VIALS, VACCINE BULBS—
WHITE & AMBER



ALL OTHER APPARATUS & EQUIPMENT
MANUFACTURED TO CLIENT'S DESIGN

INDUSTRIAL & ENGINEERING
APPARATUS CO. (PRIVATE) LTD.
CHOTANI ESTATES, PROCTOR ROAD
GRANT ROAD, BOMBAY 7

For
ZOOLOGICAL SPECIMENS
AND
BIOLOGICAL REQUIREMENTS
OF THE
LABORATORIES
AND
INSTITUTIONS

Consult:

Bombay Biological House
Dealers in Zoological Specimens
119, Hindu Colony, Dadar, Bombay 14

Established 1941

Phone: 61813

Gram: PHERETIMA



ENDECOTTS FILTERS LTD.

Laboratory Test Sieves, Metal Gauze Filters
Sieve Shaking Machines

1. Laboratory Test Sieves as per B.S.S. &
A.S.T.M. Specifications
2. "Pocket Interchanger" Sieves.
3. "Endrock" Test Sieve Vibrator.

Accredited Agents:

UNION SCIENTIFIC SYNDICATE

"DEVKARAN MANSION"

POST BOX No. 2484, 71, PRINCESS STREET, BOMBAY-2
Gram: 'PETROLIUM' Phone: 28465 SP/UNI/2

Indian Journal of Dairy Science

Established in 1948 as a medium for the advancement and dissemination of knowledge in regard to dairy science. Current Volume No. 10.

Editor: K. C. SEN, D.Sc., F.N.I.

Subscription: Rs. 12
per volume of 4 parts, payable in advance

Single Copy: Rs. 3 each

For advertisement rates and other
particulars, apply to

The Joint Secretaries
Indian Dairy Science Association
Hosur Road, Bangalore 1

"EVERYDAY SCIENCE"

A NEW QUARTERLY

to discuss and elucidate Science to-day
for the citizen in the language he
understands.

Conducted by:

THE NORTHERN INDIA SCIENCE ASSOCIATION

with the editorial co-operation of a
strong Board of eminent scientists

Annual Subscription: Rs. 6

Further particulars from:

THE SECRETARY-TREASURER
NORTHERN INDIA
SCIENCE ASSOCIATION
GOVT. COLLEGE, CHANDIGARH

INDIAN INSTITUTE OF SCIENCE LIBRARY

PHOTO
STAT

SERVICE

can supply PHOTOCOPIES of Articles, Graphs, Charts,
Illustrations, Blue Prints, etc., from the Scientific and Tech-
nical Publications available in the Library, to Scientists and
Scientific Institutions

Enlarged or Reduced Copies can also be supplied wherever possible

Size upto

11" x 6"

..

17" x 11"

..

23" x 17"

..

Rates per page, per copy

Re. 0 8 0

Re. 0 12 0

Rs. 1 4 0

(Packing charges and postage extra)

For further particulars contact:

LIBRARIAN

INDIAN INSTITUTE OF SCIENCE
BANGALORE 3, INDIA

CE"
o-day
e he

**LABORATORY
EQUIPMENT**

Gallenkamp

**SCIENTIFIC
APPARATUS**

LABORATORY STIRRER



Y
s,
-
d
e

A small but powerful Laboratory Stirrer with a shaded-pole motor rated at 380 gm. cm. torque at 1200 r.p.m. The motor has no brushes to wear out and the absence of sparking makes it safe to use with inflammable materials. It is fitted with sintered bronze self-aligning bearings for quiet running and long life. The speed of the motor remains constant at about 1200 r.p.m. irrespective of load within wide limits. The stirring load can be removed entirely and the motor speed will not exceed 1200 r.p.m. and the motor can be slowed considerably by heavy loads over short periods without damage.

Full particulars sent on application.

Please quote Catalogue No. 10022.

A. GALLENKAMP & CO., LTD. 17-29 SUN STREET, LONDON, E.C.2

Accredited Agents in India

MARTIN & HARRIS (PRIVATE) LIMITED

(SCIENTIFIC DEPARTMENT)

SAVOY CHAMBERS,

WALLACE STREET,

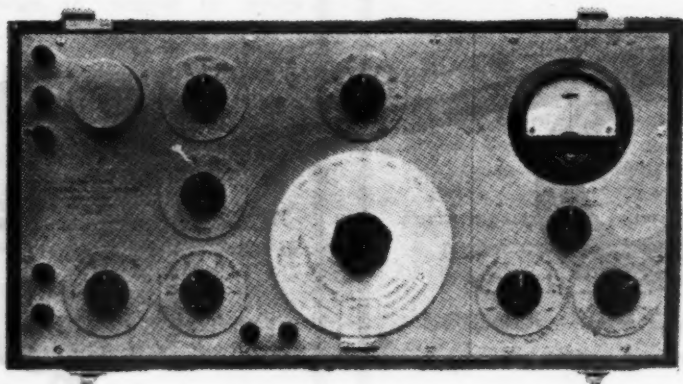
BOMBAY 1

SULLIVAN & GRIFFITHS

PORTABLE UNIVERSAL AC/DC BRIDGE TESTER

For Direct Reading Measurements of :

RESISTANCE INDUCTANCE CAPACITANCE AND
CONDUCTANCE



Ranges :

Resistance	..	0.3 ohms to 3 megohms.
Inductance	..	30 μ H to 3 H.
Capacitance	..	30 μ F to 30 μ F.
Conductance	..	0.3 micromhos to 3 mhos.
Accuracy	..	1 per cent.

Incorporates a novel feature of single calibrated dial used for the direct reading of resistance, conductance, capacitance and inductance with equal accuracy with either DC or AC. A specially devised dual impedance telephone headgear set for AC balancing enables the operator to select the correct telephone impedance with changing the headgear or even removing it.

"Sullivan" guarantees accuracy

SOLE DISTRIBUTORS

THE SCIENTIFIC INSTRUMENT CO., LTD.

Allahabad - Bombay - Calcutta - Madras - New Delhi

D.

E. FROM